EPA/ROD/R05-99/161
1999

EPA Superfund
Record of Decision:

VELSICOL CHEMICAL CORP. (MICHIGAN)
EPA ID: MID000722439
OU 02
ST. LOUIS, MI
02/15/1999

Record of Decision for Operable Unit 2 - Pine River
Velsicol Chemical Superfund Site
St. Louis, Michigan

<u>Site Name and Location</u>

The Velsicol Chemical Superfund site is located at 500 Bankston Street, Gratiot County, St. Louis, Michigan and encompasses contaminated portions of the Pine River. There are two operable units (OU) at the Velsicol Site. OU 1 consists of the 52 acre main plant site, the location of the former chemical manufacturing facility. OU2 consists of contamination in sediments and fish in the St. Louis Impoundment and Pine River.

<u>Statement of Basis and Purpose</u>

This decision document represents the selected final remedial action for OU2, contaminated sediments in the St. Louis Impoundment of the Pine River. This final remedial action was developed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Contingency Plan (NCP). The attached summary of Remedial Alternatives identifies the information contained in the administrative record for this site upon which the selection of the remedial action is based.

The State of Michigan, Department of Environmental Quality has indicated a willingness to concur with this Record of Decision. A copy of their concurrence letter will be added to the Administrative Record upon receipt.

<u>Assessment of the Site</u>

U.S. EPA and the Michigan Department of Environmental Quality (MDEQ) collected sediment and fish tissue samples from the Pine River that document concentrations of total DDT resulting in unacceptable risk to human health and the environment from fish consumption (humans and fish-eating birds).

Actual or threatened releases of hazardous substances from the site, if not addressed by implementing the remedial action selected in this Record of Decision, may present an imminent and substantial danger to public health, welfare, or the environment.

<u>Description of the Remedy</u>

The selected remedies are Alternatives 4, 5 and 6 and consist of:

- (temporary coffer dams or sheet pile;

- (removal of all contaminated sediments greater than 5 ppm total DDT using excavating equipment or dredging;
- (addition of a stabilizing/drying agent to the sediment;
- (dewatering sediment if necessary
- (water treatment with discharge to the Pine River;
- (monitoring of resuspension of sediments during removal;
- (confirmation sampling of sediments
- (transportation of sediments via truck to a landfill; and
- (disposal of sediments in either a RCRA subtitle C or D landfill (depending on level of contamination in sediments).

Operable Unit (OU) 1 of the site was completed by Velsicol in 1984 under a 1982 Consent Judgment and consisted of construction of a slurry wall and clay cap over the 52 acre main plant site. This ROD only addresses contamination in OU2, Pine River sediments.

Sediments contaminated with total DDT are the principal threat at the site. This action addresses sediments contaminated with greater than 5 ppm. total DDT by removing them from the river, dewatering them and disposing them in a landfill.

Statutory Determinations

This final remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. This remedy also satisfies the statutory preference for treatment as a principal element of the remedy (i.e., reduce the toxicity, mobility, or volume of materials comprising principal threats through treatment). Although this remedy will not result in hazardous substances remaining in sediments on-site above levels that allow for unlimited use and unrestricted exposure, a five-year review will be required for this remedial action because it will take time for contaminant levels in fish to drop to acceptable levels.

ROD Data Certification Checklist

The following information is included in the *Decision Summary* section of this Record of Decision. Additional information can be found in the Administrative Record file for this site which is located at EPA's office in Chicago or at the T.H. Cutler Memorial Library in St. Louis, Michigan.

- Chemicals of concern (COCs) and their respective concentrations
- Baseline risk represented by the COCs
- Cleanup levels established for COCs and the basis for the levels
- Estimated capital, operation and maintenance (O&M), and total present worth costs; discount rate; and the number of years over which the remedy cost estimates are

projected

- Decisive factor(s) that led to selecting the remedy (i.e... describe how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria).

The following information not included in the *Decision Summary* section of this Record of Decision because it does not apply to this site.

- Current and future land and ground-water use assumptions used in the baseline risk assessment and ROD.
- Land and ground-water use that will be available at the site as a result of tile Selected Remedy.

State Concurrence

The State of Michigan, Department of Environmental Quality has indicated a willingness to concur with this Record of Decision. A copy of their concurrence letter will be added to the Administrative Record upon receipt.

Wm. E. Muno
William E. Muno
Superfund Division Director

2/12/99
Date

RECORD OF DECISION SUMMARY

VELSICOL CHEMICAL SITE
St. Louis, Gratiot County, Michigan

February, 1999

TABLE OF CONTENTS

RECORD OF DECISION
VELSICOL CHEMICAL SITE

TABLES

APPENDICES

I. Site Name, Location, and Description

Site Name: Velsicol Chemical Site
Location: St. Louis, Gratiot County, Michigan
CERCLIS #: MID00072439
Site Lead: U.S. EPA
Type of Site: Former chemical manufacturing facility/contaminated river sediments
No. of OUs: 2

There are two operable units (OU) at the Velsicol Site. OU1 consists of the approximately 52 acre main plant site, the location of the former chemical manufacturing facility. OU2 consists of contamination in sediments and fish in the lower and middle basins of the St. Louis Impoundment of the Pine River. See Figure 2-1. The Site history contains extensive information about OU1 which is provided for background purposes only.

II. Site History and Enforcement Activities

The Velsicol Chemical Site ("Site") is an approximately 52 acre parcel that was once occupied by a chemical processing plant and contaminated sediments in the St. Louis Impoundment of the Pine River. See Figure 2-1. The chemical plant operated from 1936 through 1978 and manufactured a variety of organic and inorganic chemicals including polybrominated biphenyls (PBB), hexabromobenzene (HBB), 1, 1, 1 -Trichloro-2,2-bis(pchlorophenyl) Ethane (DDT), and Tris(2,3-Dibromopropyl) Phosphate (TRIS). The Site represented a threat to public health, welfare, and the environment because of widespread contamination caused by poor waste management practices and direct discharge to the Pine River. In 1982 U.S. EPA and the State of Michigan entered a Consent Judgment with Velsicol for the Site. In the Consent Judgment Velsicol agreed to contain in place the 52 acre main plant site where the former chemical plant was located. The parties to the Consent Judgment concluded at that time the most appropriate alternative for the Pine River sediments was to leave the sediments in place, and the Consent Judgment released Velsicol from liability for clean up of the sediments that were contaminated at the time of entry of the Consent Judgment or became contaminated from migration or discharge from the main plant site prior to completion of the Containment System. This Record of Decision (ROD) concerns only OU2, Pine River sediment and fish contamination.

The Site, including the Pine River, has been the subject of a number of investigations conducted by the Michigan Department of Environmental Quality (MDEQ), U.S. EPA and Velsicol. The studies revealed Site soils contaminated with PBB, HBB, TRIS and other contaminants; ground water contaminated with vinyl chloride, toluene, chlorobenzene, DDT and other contaminants; Pine River sediments contaminated with PBB, HBB and DDT; and elevated levels of PBB, DDT and other contaminants in fish. Pine River surface water did not contain measurable levels of contaminants associated with the Site.

Upon completion of the Site characterization in the early 1980's, the State of Michigan, U.S. EPA, and Velsicol negotiated an agreement that included a remedy directed at stopping the migration of PBB, HBB, DDT and other contaminants found at the Site into the environment. The remedy selected consisted mainly of a 2 foot thick, low-permeability slurry wall around the 52 acre facility and a 3 foot thick, low-permeability, clay cap. Under the Consent Judgment Velsicol must maintain ground water levels within the slurry wall and cap ("Containment System"). Construction of the Containment System was completed by Velsicol in 1984. The Site was proposed for inclusion on the National Priorities List (NPL) on December 30, 1982, and appeared on the final NPL on September 8, 1983.

The 52 acre main plant site is now covered with shallow-rooted grass, and, to restrict access, enclosed by a chain link fence. Velsicol is currently operating and maintaining the Site in accordance with an approved operation and maintenance plan requiring weekly inspections for signs of deterioration, quarterly monitoring of gas vents, measurement of groundwater levels within the contained Site, and slurry wall permeability testing.

The Consent Judgment did not require Velsicol to remove the contaminated sediments from the Pine River/St. Louis Impoundment. A 1988 Preliminary Health Assessment prepared by the Michigan Department of Public Health (MDPH) and the Agency for Toxic Substances and Disease Registry (ATSDR) concluded the river poses a potential public health concern because of possible human exposure to contaminants via ingestion of fish and direct contact with river sediments. The concern with potential fish consumption was reiterated in 1993 in an MDPH/STSDR Site Review and Update. Contamination of fish in the river was addressed by health advisories issued by the State of Michigan. A no consumption advisory for all species of fish was initially published in the Michigan fishing guides in 1977, and is presently in effect. The no consumption advisory affects 33 river miles of the Pine River.

Water levels inside the Containment System (slurry wall and cap) remained below the level set by the 1982 Consent Judgment until February 1993. In 1993 Velsicol had to pump 1.25 million gallons of water from the Containment System to stay below the established level. In late 1994 Velsicol removed another 1.28 million gallons of ground water from the system to maintain the level set in the Consent Judgment. Velsicol has continued to pump water from the Containment System approximately every 6 months to maintain the required water level, and Velsicol has been disposing of this water off-Site. Meanwhile the State collected fish samples in late 1994 and noted that the average concentration of total DDT in skin-off filet carp samples more than doubled since the last collection in 1989. Average concentration of total DDT in 1989 was 10.5 ppm, in 1994 tissue concentrations were 23.3 ppm. The State collected fish again in 1995 and found an average total DDT concentration in skin-off filet carp samples of 16.1 pprn. The contaminant concentrations in fish tissue coupled with the water intake to the Containment System caused concern that the Containment System may have failed increasing the loading of DDT into the Pine River.

Velsicol agreed to reassess the Containment System to ensure that it was not a source of DDT into the Pine River. At the same time U.S. EPA and MDEQ (the Agencies) reassessed sediment contamination in the Pine River and decided to reconsider the no action decision made in 1982.

In 1996, Velsicol completed a comprehensive assessment of the Containment System. Velsicol's assessment of the clay cap included collection of samples from the upper portion of the cap and analysis for permeability, grain size, and Atterberg limits. Assessment of the containment wall consisted of installation of inclinometers inside and outside the slurry wall at seven locations, installation of settlement plates at seven locations inside the slurry wall, collection of samples at nine locations for permeability analysis; installation of upper zone piezometers on the inside and outside of the wall at five locations; water level measurements and free product screening from all monitoring wells and piezorneters; and a dye tracer study at the five locations where the piezometers were installed. Velsicol published a report entitled *Final Containment System Assessment Report, Former Michigan Chemical Plant Site, St. Louis, Michigan, October 1, 1997* detailing the Containment System assessment and results.

The Agencies believe the results of the Containment System Assessment document that the clay cap is leaking, probably because there is no frost protection layer on top of the cap. No obvious problems were documented with the slurry wall. Velsicol concluded in their report of the findings that the Containment System is working as designed. On December 11, 1997 Velsicol submitted a work plan entitled *Work Plan Post-Closure Cap Maintenance, Former Michigan Chemical Plant Site, St. Louis, Michigan* in which Velsicol states it will conduct maintenance of the clay cap during summer, 1998 by recompacting areas of the clay cap. Velsicol decided to delay this work until U.S. EPA and MDEQ completed the sediment removal project.

Simultaneously with the Containment System Assessment, the Agencies began a reassessment of contamination in the Pine River/St. Louis Impoundment. During summer, 1996 sediment cores were collected from 23 locations in the St. Louis Impoundment and analyzed for PBB, HBB and DDT. Surficial sediment samples were also collected from depositional areas in the lower Pine River (below the St. Louis darn). During summer, 1997 the Agencies collected another round of sediment cores from 28 locations and analyzed them for DDT and total organic carbon (TOC). MDEQ collected fish for analysis.

On June 8, 1998 U.S. EPA signed an Action Memorandum for a time-critical removal action at the Site. The removal action consists of dredging/excavating sediments containing 3,000 ppm total DDT or greater (the hot spot), treatment of the sediments with a stabilizing/drying agent and disposal of the sediments off-Site. The removal action also includes building the infrastructure necessary to complete the removal action such as roads, staging pad, and water treatment plant. Construction of the infrastructure was substantially complete by November, 1998. Sediment removal is expected to begin in spring, 1999.

III. Community Participation

The streamlined Remedial Investigation/Feasibility Study (RI/FS) Report and Proposed Plan for the Velsicol Site were made available to the public in August, 1998. They can be found in the Administrative Record file and the information repository maintained at the U.S. EPA docket room in Region 5 and at the T.H. Cutler Memorial Library in St. Louis, Michigan. The notice of the availability of these two documents was published in the Alma Morning Sun newspaper on September 9 and 13, 1998. A public comment period was held from September 8, 1998 to October 8, 1998. A request for an extension to the public comment period was not received by U.S. EPA. A public meeting was held on September 16, 1998 to present the Proposed Plan to a broader community audience than those that had already been involved at the Site. At this meeting, representatives from U.S. EPA and the MDEQ answered questions about problems at the Site and the remedial alternatives. U.S. EPA's responses to the comments received during this comment period are included in the Responsiveness Summary, which is part of this ROD.

IV. Scope and Role of Operable Unit

As with many Superfund sites, the problems at the Velsicol Chemical Site are complex. As a result, U.S. EPA has organized the work into two operable units (OUs):

- Operable Unit 1: Main plant site soils and groundwater
- Operable Unit 2: Contaminated sediments and fish in the Pine River and St. Louis Impoundment

U.S. EPA, the State of Michigan and Velsicol Chemical Co. already agreed to a remedy for Operable Unit 1 in a 1982 Consent Judgment. This remedy, on-Site containment of contaminated soils and groundwater was implemented by Velsicol in 1984.

The second operable unit, the subject of this ROD, addresses the contaminated sediments in the St. Louis Impoundment of the Pine River. Ingestion of fish from the Pine River poses a current and potential risk to human health because U.S. EPA's acceptable risk range is exceeded. This second operable unit presents the final response action for this Site and addresses a principal threat at the Site through the removal, treatment and disposal of contaminated sediments.

V. Characteristics of Pine River

The Pine River is part of the Saginaw River/Saginaw Bay drainage basin with a total drainage area of 312 square miles. The Pine River flows northeast toward Midland for 20.5 miles where it discharges into the Chippewa River and then into the Tittabawassee River. The Tittabawassee then flows southeast toward Saginaw where it discharges into the Saginaw River. The Saginaw River then flows north where it empties into Saginaw Bay in Lake Huron (Figure 2-2).

The Pine River is impounded in both Alma and St. Louis. The Alma dam is located approximately 4-5 miles upstream from the Site. The St. Louis Impoundment is adjacent to the Site and immediately downstream of the Site is the St. Louis dam.

The portion of the Pine River and St. Louis Impoundment subject to consideration in this document includes the Pine River from approximately the M-46 bridge to the Mill street bridge. The total area of this stretch is approximately 25 acres. The St. Louis Impoundment is identified in Figure 2-1 as the middle and lower basins and also identifies the areas described as the Main Plant Site, the Pine River, the M-46 bridge, the Mill Street bridge and the St. Louis dam.

The Pine River is a navigable waterway. Current uses of the Pine River and St. Louis Impoundment are impaired due to the sediment contamination. While sportfishing is not strictly prohibited, anglers are limited to catch and release fishing by the no consumption fish advisory.

The advisory, however, is not easily enforceable. Swimming and boating are considered undesirable due to the contamination. Generation of electricity is currently the only acceptable use of the river and impoundment. The impoundment provides hydraulic head for power generation. The City of St. Louis estimates that from July 1996 to June 1997 the St. Louis dam generated 1.35 million kilowatt-hours of electricity, 4% of the total kilowatt-hours sold to the City of St. Louis during that same time frame.

The closest gauging station to the Site is located on the right bank of the Pine River, 270 feet downstream from the Superior Street Bridge in Alma. The location is 0.6 mile downstream from the Alma dam and 5.2 miles upstream from the St. Louis dam. (USGS End of Year Report, 1993).

Within the St. Louis Impoundment, the water depth to sediment is generally between 7 and 10 feet. The maximum observed depth during June 1993 sampling was 12 feet near the inlet to the hydroelectric plant.

The City of St. Louis participates in the national Flood Insurance Program. A Flood Insurance Study (FIS) was prepared for the Pine River in the City of St. Louis by the Federal Emergency Management Agency (FEMA) in 1989. The FIS indicates that flooding in the City of St. Louis is primarily caused by overflow of the Pine River, however, the potential for flood damage is not great because of the steep banks and flood elevation regulation provided by the St. Louis dam. The FIS presents the methodology and results of hydrologic and hydraulic analyses performed for the Pine River to determine water-surface elevations corresponding to the 100-year discharge both upstream and downstream of the dam. Upstream of the dam, where the contaminated sediments are located the flood profile is based on a starting water surface elevation at the dam that was derived from a series of 38 annual maximum pool elevations as provided by the dam operator. The U.S. Federal Highway Administration's WSPRO model was used to compute water surface elevations on the Pine River for the St. Louis FIS.

Sediment Data Summary

Sediment data was collected from the Pine River/St. Louis Impoundment in 1980, '81, '96 and '97. This summary presents only the 1997 data. Sediment data from 1996 was used to evaluate the lower basin because an equipment failure precluded the collection of sediment cores from that area in 1997. Body burden of contamination in fish has been monitored by MDEQ since 1983. Fish collection and analysis were completed in 1983, '85, '94, '95 and '97. A detailed summary of all historic fish surveys is presented in this summary because ingestion of contaminated fish is the main exposure pathway. The risk assessment in the RI/FS Report identifies PBB, total DDT, and HBB as chemicals of concern for the Site.

In July of 1997, the U.S. EPA and MDEQ conducted sediment sampling in the Pine River and the Impoundment area. The survey was intended to supplement the May 1990 survey and provide additional information regarding the nature and extent of the DDT contamination in the Pine River. A total of 28 cores and 3 grabs were collected and partitioned into 0 to 6, 6 to 30, 30 to 54 and 54 inches to refusal depth intervals. A total of 77 samples were analyzed for total DDT contamination and total organic carbon (TOC). All sample locations are identified on Figure:2-10. On the last day of the survey the sampling equipment malfunctioned; therefore only grab samples (surficial) were obtained instead of core samples in the lower basin at Stations 27, 28, 29, 30, and 31.

The horizontal extent of total DDT in sediments of the Pine River and St. Louis Impoundment was estimated based on the 1996 and 1997 data as explained above. The maximum concentration of total DDT at each sample location was evaluated. Interpolation of the maximum concentration was completed to delineate the surface area of total DDT concentrations exceeding 1, 10, 100, 500, and 1,000 ppm. The surface areas and depth was used to estimate the volume of sediment associated with each concentration (i.e., 1, 10, 100, 500 and 1,000 ppm). The areas and volumes for each concentration are presented on Figures 2-3 through 2-6 and in Table 2.2-3.

Table 2.2-3: Concentration, Area, Volume and Mass of DDT in St. Louis Impoundment

Concentration (ppm)	Area (acres)	Volume (cy)	Mass(lb)
1	65	516,650	540,000
10	31	260,330	533,000
100	20	169,000	529,000
500	12	104,200	519,500
1000	6	48,000	490,700

As shown in Table 2.2.1.4-1, sediment total DDT concentrations ranged from 1.3 to 32,600 ppm. Of 77 samples, none of the samples indicated total DDT concentrations less than 1 ppm, 44 were between 1 and 10 ppm, 14 were between 10 and 50 ppm, 3 were between 50 and 100 ppm, 14 were between 100 and 1000 ppm, and 7 samples were greater than 1000 ppm total DDT.

Table 2.2.1.4- 1: Total DDT Concentration per Depth Interval (1997 Data)

Depth Interval (in.)	Max. Conc. (ppm)	Avg. Conc. (ppm)	Min. Conc. (ppm)
0 - 6	229.	28.4	1.3
6 - 30	32,600*	1485	1.8
30 - 54	32,600*	1639	2.1
54 - 112	822	130	2.4

* The maximum concentration was found in a sample collected from 6 to 42 inches.

The average TOC content of the impoundment surface sediment was 3.1 percent. The average TOC content of subsurface samples was 3.5 percent.

Based on the data obtained from the sediment surveys several observations can be made. First, the location of the maximum total DDT concentrations were consistently found in the sediment depth interval ranging from 6 to 42 inches. This area includes the Impoundment from the Site plant jetty to the Mill Street bridge in the middle basin.

Results from all sediment surveys indicate that the levels of total DDT in the Pine River and the St. Louis Impoundment are extremely high. Analyses from the 1980, 1981, 1996, and 1997 data show that the concentration levels, as a whole, have not decreased over time.

Five sediment grab samples were collected by MDEQ in the Pine River between the St. Louis dam and the confluence with the Chippewa River. Significant amounts of total DDT were not found in sediments below the St. Louis dam. The results are summarized in Table 2.2.1.3-2.

Table 2.2.1.3-2: Total DDT Concentrations in Sediment below St. Louis Dam

Location	Total DDT (ppm)
McGregor Road	0.566
downstream of Bagley Road	0.117
Magrudder Road	0.258
9 Mile Road	0.143
Meridian Road	none detected

Fish Data Summary

Fish tissue samples were collected from the St. Louis dam by the MDEQ in 1983, ‘85, ‘89, ‘94, ‘95 and ‘97. Generally, fish tissue samples were analyzed for DDT, DDE, DDD and PBB. This summary of fish data focuses on trends in skin-off filet (Fs) carp samples since this was the only sample type consistently collected. Table 2.2.2-1 summarizes the maximum, average and minimum concentration of total DDT in skin-off filet samples of carp. Table 2.2.2-2 illustrates specific sampling factors that may explain variability in the data and highlights data trends.

Table 2.2.2-1: Skin-off Filet Carp Samples

Collection Date	Species	Type	Mas. Conc. (ppm)	Aveg. Conc. (ppm)	Min. Conc. (ppm)
1983*	Carp	Fs	0.10	0.06	0.03
1958	Carp	Fs	18.66	9.66	5.27
1989	Carp	Fs	39.80	10.50	0.06
1994 ·	Carp	Fs	47.30	23.30	1.58
1995	Carp	Fs	43.30	16.10	0.50
1997	Carp	Fs	89.92	34.57** 26.82**	2.47

* Fish collected in 1983 were not analyzed for DDD and DDE

** 34.57 ppm total DDDT is the average concentration for fish collected in the St. Louis Impoundment, 26.82 ppm total DDT is the average concentration for fish collected below the St. Louis dam.

Table 2.2.2-2: Carp Data Specifics

	op dde avg	pp dde avg	op ddd avg	pp ddd avg	op ddt avg	pp ddt avg	max % fat	avg % fat	min % fat	max wt	avg wt	min wt	location
1983 (8)	–	–	–	–	–	.08	–	–	–	3674	2403	680	below dam
1985 (8)		2.7		0.7		.20	10.8	4.45	2.0	1380	1209	1050	below dam
1989 (10)		3.1		6.1		.29	6.65	2.08	.7	1810	1149	820	Impound
1994 (10)		6.7		15.		.32	13.1	5.53	0.6	2480	2001	1460	below dam
1995 (10)		4.9		10.		.17	4.1	2.09	0.6	4360	1789	920	Impound
1997													
(12b)		5.9	4.6	15.	.81	.38	18.5	6.56	2.45	4680	2819	1500	Below Dam (12)
(8i)		8.6	6.2	15.	3.1	.97	10.4	3.15	1.10	5595	3099	1900	Impound (8)

Each of the breakdown products that make up total DDT (DDD, DDE and DDT) have two isomers, ortho para (“op”) and para para (“pp”).

In 1985 all eight carp samples obtained below the dam exceeded the Michigan Department of Community Health (MDCH) and Federal Food and Drug Administration (FDA) tolerance level of 5 ppm. Eight of the 10 carp samples collected in 1994 and all 12 of the carp samples collected in 1997 (below the dam) exceeded MDCH and FDA tolerance level of 5 ppm for total DDT in fish.

In 1989 four of ten carp samples collected in the Impoundment exceeded the MDPH and FDA tolerance level of 5 ppm. Six of ten carp samples collected in 1995 and six of eight of the carp samples collected in 1997 (in the St. Louis Impoundment) exceeded the 5 ppm. tolerance level for total DDT in fish.

It is difficult to draw conclusions from the data due to variabilities (weight, age, % fat, number of samples collected, etc.), however, what is clear is that carp in the St. Louis Impoundment and below the St. Louis dam are bioaccumulating high levels of total DDT and there are no indications, from the 14 years of data, of a downward trend. If any conclusion could be drawn it would be that contaminants in sediments continue to be increasingly bioavailable to fish. Fish in the Pine River are highly contaminated and will continue to be if no remedial action is taken at this Site.

Surface Water Data Summary

Fourteen water samples were collected in June, 1980 from the Pine River between the Cheeseman Road bridge and the St. Louis Municipal wastewater treatment plant outfall to document the contamination of the Pine River. These samples were collected in one gallon glass containers using a battery operated vacuum pump with teflon tubing. The samples were tested for PBB, HBB, DDT and its analogs, and subjected to a limited organic scan.

The Pine River water samples did not contain measurable concentrations of HBB, PBB, or DDT analogs. Elutriate testing under laboratory conditions showed that these contaminants are bound tightly with the sediment and do not readily desorb and solubilize from the sediments to the water. Only a small amount of p,p-DDT was detected in the water from the static phase of the testing. The amount desorbed was less than 0.01% of the amount present in the sediment.

Two water samples, RWS-6-01 and RWS-6-02, did contain 3.5 Fg/l and 2.7 **Fg/l** methoxychlor, respectively. The origin of this compound in the samples is not known.

In October of 1992 water sampling was again conducted. The City of St. Louis had a water quality study completed in the area surrounding the St. Louis dam. Six samples were collected by Ayers, Lewis, Norris, & May, Inc. Three of these samples were taken above the dam, and three samples were taken below the dam. The samples were tested and reported as two composites, above and below the darn.

The laboratory results showed levels of total DDT, other hydrocarbons and pesticides, and BTEX for the two composites to be below the method detection level. While most heavy metals were at or below the analytical detection limit, the City sampling event showed insignificant treaces of some heavy metals.

VI. Current and Potential Future Site Uses

The portion of the Velsicol Site currently under investigation is the St. Louis Impoundment. Due to the high levels of contamination in the sediment of the St. Louis Impoundment and in fish in the Pine River the only current acceptable use of the river is generation of electricity. However, U.S. EPA is aware that some local residents fish despite the no consumption fish advisory and there is a migrant farm worker population that comes to St. Louis every summer to live in camps and work on the surrounding farms. U.S. EPA’s risk assessment assumes that this population will fish the Pine River to supplement their diet, and that fish eating birds are fishing in the Pine River.

If the clean-up goal is attained, use of the river and impoundment should be unrestricted in the future. Eventually, fish are expected to be clean enough for humans and birds to eat. All types of recreational activities would be available, swimming, wading and canoeing. The impoundment will continue to provide hydraulic head for the generation of electricity.

VII. Summary of Site Risks

This section presents a summary of the key findings of the baseline risk assessment for OU2. The risk assessment in the RI/FS Report identifies PBB, total DDT, and HBB as chemicals of concern for the Site. The risk assessment determined that the main exposure pathway is through ingestion of contaminated fish. Chemicals detected in fish in 1997 above the detection limit were mercury, DDT and its metabolites, chlordane congeners, PBB, hexachlorobenzene and octachlorostyrene. The DDT concentration in most of the fish collected exceeded the Michigan Department of Community Health (MDCH) Level of Concern of 5 ppm total DDT. The mercury and chlordane concentrations did not exceed the MDCH Levels of Concern. MDCH has no official Level of Concern for the other chemicals detected.

Risk associated with dermal contact considered absorption of total DDT, PBB, and HBB.

Human Health Risks

The baseline risk assessment estimates what risks the Site poses if no action is taken. The baseline risk assessment provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action.

DDT and its breakdown products DDD and DDE, PBB and HBB are the chemicals of concern for this OU. Due to their hydrophobic and lipophilic characteristics, the contaminants are partitioned in sediments and bioaccumulated in fish tissue. DDT, DDD and DDE were found at the highest concentrations in fish tissue and sediments and therefore are the basis for the human health and ecological risk assessments. Because DDT, DDD and DDE are extremely bioaccumulative, the chief exposure threat is through the food chain, from consuming contaminaed fish from the Pine River. People may also be exposed to contaminants during wading (or other recreational activities) due to direct contact of their skin with sediment. While this may not occur frequently, it is thought to occur to some degree given the very close proximity of many homes to the river and lack of any appreciable barriers separating backyards from the River (including vegetation, presence of any banks, dock faces, etc.). Other exposure routes such as inhalation or surface water ingestion are thought to be minimal and insignificant compared to ingestion of fish and direct contact with sediments, because of the low level volatility of DDT and it's strong partitioning to sediment. These exposure routes were not assessed further in the risk assessment.

Exposure scenarios are defined by the exposure assumptions used, Table 1 lists all exposure assumptions used in all scenarios. In this analysis, the critical assumptions that help define scenarios were:

- ingestion rate (how many grams a day of fish people consume),

- fraction ingested (how much fish consumed comes from Pine River)
- type of fish consumed (sport fish vs. bottom feeding fish)

A study done by West et al. on Michigan anglers provides useful data on ingestion rates for the various scenarios. For the lower bound estimate, the 50th percentile ingestion rate from this study was used (a daily average of 20 grams per day). For the reasonable maximum exposure (RME), the 95th percentile ingestion rate was used (a daily average of 75 grams). Given the quality and specificity of this study for use at this Site, there is a good deal of confidence that these exposures are reasonable and do occur for some portion of the population. For the RME scenario, a study of a three day maximum fish consumption was used instead of West data. This again is in line with a worst case scenario. For fraction ingested from Pine River, study assumptions were made that reflect the different scenarios. For the lower bound or sport fishing scenario, 50 % was used, meaning of the total amount of fish consumed, 25 % comes from the Pine River. In the RME U.S. EPA assumed that 50% of fish consumed comes from the Pine River, and for the subsistence scenario U.S. ERA assumed that all fish comes from the Pine River.

TABLE 1. Exposure Assumptions

	SPORT	RME	SUBSIS.
Body weight (kg)	[illegible]	70	[redacted]
Averaging time (days)	[illegible]	25550	[redacted]
Ingestion rate (kg/day)	0.02	0.075	[redacted]
Fraction ingestion (%)	0.25	0.5	[redacted]
Absorption (%)	[illegible]	1	[redacted]
Exp. frequency (days/year)	[illegible]	365	[redacted]
Exposure duration (years)	[illegible]	9	[redacted]

The recent sediment data collected in July 1997 and fish data collected in October 1997 were assessed to estimate current risks of consumption of contaminated fish and dermal risks. Both cancer effects and noncancer effects of DDT were assessed. The noncancer effect being assessed here is liver lesions.

Toxicity

DDT and its breakdown products (DDD and DDE) are classified as probable human carcinogens based on liver tumors, lung tumors and thyroid tumors in rodents. DDT, DDD and DDE are all structurally similar. Both hepatocellular adenomas and carcinomas were observed in six mouse liver tumor studies upon treatment with DDT. The cancer slope factor for DDT, as obtained from IRIS (1997) is 0.34 $(mg/kg\text{-}day)^{-1}$. Treatment of mice with DDD resulted in a statistically significant increase in incidence of lung tumors in both sexcs of mice when compared to controls. The cancer slope factor for DDD is 0.24 $(mg/kg\text{-}day)^{-1}$. DDE administered to mice resulted in a dose-dependent and statistically significant increase in incidence of hepatocellular carcinomas in both males and females in comparison to controls. The cancer slope factor for DDE is 04 $(mglkg\text{-}day)^{-1}$

A slope factor for assessing cancer risks assumes that cancer risk is probabilistic and any degree of exposure leads to some degree of risk. A slope tactor relates estimated exposures to incremental lifetime cancer risks, and therefore the result is a probability of cancer over the background levels in the population. Therefore a risk result of 7 E-4 is equivalent to saying there is an increase cancer risk at a rate of 7 in 10,000 people. This assessment combines the data for DDT and its breakdown products, DDD and DDE, and applies the cancer slope factor of 0.34.

DDT and its breakdown product (DDD and DDE) have also been reported to exert non-cancer effects. IRIS specifically calculates a Reference Dose (RfD) for DDT based upon liver toxicity in rats. The RfD was based upon a study performed in adult male rats and is 0.0005 mg/kg-day. An RfD is intended to indicate a safe level exposure, meaning that exposure at the RfD level is likely to be without an appreciable risk of deleterious effects. To assess non-cancer risks, a hazard index of the estimated exposure over the RfD is calculated. Because the RfD represents a safe level, the hazard index should be one or less than one. The higher the hazard index the higher the likelihood of adverse effects.

In addition, DDT and its breakdown products (DDD and DDE) are undergoing increasing scrutiny for their role as endocrine disrupting compounds. As endocrine disrupters, DDT has the potential to negatively impact the developing fetus, increase vulnerability to certain cancers, and possibly decrease fertility. While conclusive studies have not been done in order to develop an RfD based on these endpoints, the current evidence suggest some endocrine disrupting potential for DDT and its breakdown products. Due to the tremendous uncertainty around this endpoint, this risk assessment applies the RfD for DDT (calculated based upon liver toxicity in adult male rats) to the breakdown product of DDT (DDD and DDE) for which no RfD has been calculated.

Polybrominated biphenyls (PBB) are classified as probable human carcinogens based on liver tumors in rats. Both carcinomas as well as neoplastic nodules were observed in rats treated with PBB. The cancer slope factor for PBB, as obtained from HEAST (1995), is 8.9 $(mg/kg\text{-}day)^{-1}$.

PBB has also been reported to exert non-cancer effects. HEAST reports an RfD for PBB based upon liver toxicity in rats as 7×10^{-6}. In addition, PBB is undergoing increasing scrutiny for its role as an endocrine disrupting compound. As an endocrine disrupter, PBB has the potential to negatively impact the thyroid, the developing fetus, increase vulnerability to certain cancers, and possibly decrease fertility.

Hexabromobenzene (HBB) does not have a carcinogenicity assessment entered into either IRIS or HEAST. An RfD has been calculated for HBB based upon induced serum carboxyl esterase activity and increased liver-to-body weight ratio. The RfD for HBB is 0.002 mg/kg-day.

The confidence in the RfD is low because the critical study was of short duration, only one sex (male) was exposed, and few definitive parameters were examined.

The hazard indices from all three chemicals can be appropriately added because of the shared target organ of the liver.

Risk Characterization

Fish consumption

Risks were estimated by using the 1997 fish data, both the smallmouth bass and carp data were used, along with the exposure assumptions for each scenarios described in Table 1. A summary of the risks for each species for each exposure scenario is shown in Table 2.

TABLE 2. Current Risks from Fish Consumption

	Cancer	sport	RME	subsis.	Hazard	sport	RME	subis.
Smallmouth bass		3.6 E-05	3 E-05	4 E-03		0.21	1.7	22.6
Carp		1 E-04	1E-03	1.6 E-02		0.63	6	95

Table 2 clearly shows risks are within or exceeding the target risk range of E-4 - E-6 for all exposures and all species. Even consumption of bass, which is frequently much less contaminated than other fish, is of significant concern. The RME estimate for both species shows that for any combination of fish caught, risk increases and even recreational fishing with only 50% coming from this Site is not without risk.

Dermal Risks

Risk of cancer via dermal contact with the sediments was estimated for a typical exposure using concentrations in the top 6 inches of sediment and a reasonable maximum exposure, using the maximum at subsurface levels of sediment. Table 3 shows current risks from dermal exposures using 1997 data. Table 3 shows the current risk from dermal exposure using 1997 data.

TABLE 3. DERMAL CANCER RISKS USING 1997 DATA

Typical (0-6 in. Sediment)	RME (maximum at subsurface)
2.0E-05	2.0E-02

Ecological Risk

This section presents a summary of the key findings of the ecological risk assessment for OU2 as presented in the RI/FS Report. The results of the ecological risk assessment show that fish-eating birds, as represented by great blue heron, that consume fish from the St. Louis Impoundment are at risk for reproductive impairment related to eggshell thinning and other adverse effects caused by DDE. The calculated dose of DDE to heron (2.04 mg DDE/kg_{BW}-d) is 3 times greater than the DDE lowest observed adverse effect level (LOAEL) of 0.7 mg DDE/kg_{BW}-d, and 30 times greater than the no observed adverse effect (NOAEL) of 0.07 mg DDE/kg_{BW}-d (Table 2.4-6). Adverse reproductive effects would therefore be expected in heron that obtain one-third or more of their diet from the St. Louis Impoundment. Adverse effects are unlikely to occur in fish-eating birds that obtain no more than 3 % of their diet from the St. Louis Impoundment.

The preliminary remedial goal (PRG) for sediments is 1 ppm DDT to be fully protective of reproduction in fish-eating birds. This sediment concentration should result in 0.5 mg DDE/kg whole fish, the dietary concentration that corresponds to the NOAEL. Adverse reproductive effects may be expected when mean sediment levels exceed 8 to 12 ppm DDT, which should result in about 5 mg DDE/kg whole fish (LOAEL). These levels are based solely on the adverse effects associated with DDE, and do not consider the potential additive effects associated with DDD or untnetabolized DDT.

Concentrations of DDT in St. Louis Impoundment sediments exceed sediment screening values for potential adverse effects on benthic invertebrates. Two-thirds of the surface sediment samples also exceed the severe effect levels (SEL) that indicate a potential for adverse effects on the majority of benthic organisms. Forty percent of the surface sediment samples exceed the threshold for effects on benthic populations as determined at another Site. Three samples from the middle basin exceed the median lethal concentration (LC_{50}) determined in sediment toxicity tests at another Site.

Although these comparisons do not prove that the contamination in the St. Louis Impoundment are adversely affecting benthic invertebrates (because Site-specific studies have not been performed), they indicate that adverse effects are likely and support the conclusion for fish-eating birds that the Site represents a significant ecological risk.

Basis for Action

Actual or threatened releases of hazardous substances from this Site, if not addressed by implementing the response action selected in this ROD, may present a current or potential threat to public health, welfare, or the environment.

VIII. Remediation Objectives

This section identifies the Site-specific Remedial Action Objectives (RAOs). These RAOs Pertain to “general Site cleanup” or are intended to fulfill potential federal and state Applicable or Relevant and Appropriate Requirements (ARARs) and “to be considered” criteria (TBCs). The RAOs proposed for this Site, where DDT and its breakdown products are the primary constituents of concern, are as follows:

- C Reduce DDT concentrations in fish and sediments in the St. Louis Impoundment to levels that would not present an unacceptable human- health or ecological risk and would allow eventual elimination of existing fish consumption advisories;
- C Prevent direct human contact with contaminated sediments;
- C Prevent significant down river migration of contaminated sediments;
- C Achieve compliance consistent with federal and state ARARs for the Site; and
- C Comply with risk-based objectives defined by the risk assessment.

IX. Description of Alternatives

U.S. EPA Region 5 is recommending waste removal alternative 4 and disposal alternatives 5 and 6. Alternative 4 consists of hydraulic modification of the Pine River, excavation of sediments above 5 ppm, total DDT (approximately 260,000 cu. yds.). Alternative 5 consists of disposal of contaminated sediment in a RCRA subtitle D landfill and Alternative 6 consists of disposal of contaminated sediment in a RCRA subtitle C landfill. Each of the alternatives considered are described below. The Ion-g4erni operations and maintenance costs were calculated for a 30 year period at an 8% discount rate.

<u>Alternative 1</u>: No Action - This alternative involves taking no additional action at the Site, but includes fish tissue monitoring and fish advisories that are currently in place. This alternative serves as a baseline against which other alternatives are evaluated.

Waste Removal Alternatives

<u>Alternative 2A</u>: Hydraulic Dredging, Dewatering and Water Treatment - Alternative 2A considers hydraulic dredging of sediments with DDT concentrations in excess of the identified action level (approx. 260,000 cu. yds.), dewatering of sediments, addition of a stabilizing agent, water treatment and discharge to the Pine River/St. Louis Impoundment. The water treatment will be designed to meet surface water discharge requirements and will probably consist of clarification, sand filtration, carbon filters and 1 micron bag filters. During dredging operations monitoring will be conducted to ensure protection of workers and the community. Monitoring of resuspension will be done directly downstream of the dredging operations. Air monitoring will be conducted. After completion of the dredging project sediment samples will be collected to ensure the clean-up standard has been met. The State of Michigan will continue to monitor fish tissue levels.

<u>Alternative 3A</u>: Mechanical Dredging, Dewatering and Water Treatment - Alternative 3A considers gasketed clamshell dredging of sediments with DDT concentrations in excess of the identified action level (approx. 260,000 cu. yds.), dewatering of sediments, addition of a stabilizing agent, water treatment and discharge to the Pine River/St. Louis Impoundment.

The water treatment will be designed to meet surface water discharge requirements and will probably consist of clarification, sand filtration, carbon filters and 1 micron bag filters During dredging operations monitoring will be conducted to ensure protection of workers and the community. Monitoring of resuspension will be done directly downstream of the dredging operations. Air monitoring will be conducted. After completion of the dredging project sediment samples will be collected to ensure the clean-up standard has been met. The State of Michigan will continue to monitor fish tissue levels.

Alternative 4: Hydraulic Modification of the Pine River, Excavation of Sediments, Dewatering and Water Treatment. Alternative 4 is similar to Alternative 3A except that temporary cofferdams will be placed in the St. Louis Impoundment, water will be pumped from the cofferdam, the sediments will be excavated instead of dredged, a stabilizing agent will be added and water will be treated prior to discharge to the Pine River. The water treatment will be designed to meet surface water discharge requirements and will probably consist of clarification, sand filtration, carbon filters and 1 micron bag filters. During excavation operations monitoring will be conducted to ensure protection of workers and the community. Monitoring of resuspension will be done directly downstream of the excavation operations. Air monitoring will be conducted. After completion of the dredging project sediment samples will be collected to ensure the clean-up standard has been met. The State of Michigan will continue to monitor fish tissue levels.

Contaminated Sediment Disposal Options

Alternative 5: This alternative considers disposal of sediment in a commercially operated RCRA subtitle D landfill located in the State of Michigan.

Alternative 6: This alternative considers disposal of sediment in a commercially operated RCRA subtitle C landfill.

Containment Option

Alternative 7: This alternative considers capping all the contaminated sediments in place. Alternative 7 considers the placement of a sand cap with a stone armoring system consisting of a 20-inch coarse-grained sand cap and 5- to 7.5-inch diameter stone armor layer. Monitoring would occur every 2-3 years and cap replenishment would occur every 5 years.

Alternative	Capital Costs	O&M Costs/Year	20 yr. Present Worth Costs	Total Cost
1: no Action	$0	$16,000	$180,000	$ 180,000
2A. Hydraulic Dredging	$22.4M	$0	Not Applicable	$22.4M
3A: Mechanical Dredging	$20.7M	$0	Not Applicable	$20.7M
4: Temporary Dams and Excavation	$16.9M	$0	Not Applicable	$16.9M
5: RCRA Subtitle D Landfill	$ 3.2M	$0	Not Applicable	$ 3.2M
6: RCRA Subtitle C Landfill	$17.4M	$0	Not Applicable	$17.4M
7: Capping	$ 7.5M	$30,100	$ 7.84M	$ 7.8M

X. Summary of Comparative Analysis of Alternatives

Alternative 1, the No Action alternative, would not provide adequate protection of human health or the environment. The risk assessment documents that unacceptable risk would occur to humans and fish-eating birds if fish are ingested from the Pine River. These risks cannot be adequately addressed through fish advisories, especially for fish-eating birds. Therefore, the No Action alternative acts as a baseline to compare Alternatives 2A, 3A, 4 and 7 against. Alternative 5 and 6 cannot stand alone, and must be paired with one of the sediment removal options.

Alternatives 2A, 3A and 4 are very similar; they all entail the removal of contaminated sediments above 5 ppm total DDT. The only difference between these alternatives is the method for removal of the sediments. Alternative 2A considers hydraulic dredging, Alternative 3A mechanical dredging, and Alternative 4 considers excavation. All of these removal methods are implementable at this Site. Alternative 4 is preferable over alternatives 2A and 3A because excavation is the most efficient way to remove sediments and will produce the least-amount of water that will require treatment. However, U.S. EPA recognizes that installation of temporary coffer dams may not be implementable in all locations in the St. Louis Impoundment and therefore some of the sediment removal may need to be completed using mechanical or hydraulic dredging.

Alternatives 5 and 6, disposal in a Subtitle D and C landfills respectively, are both considered to be favorable. Subtitle C landfill will be used to dispose of the highly contaminated sediments and a Subtitle D landfill will be considered for disposal of less highly contaminated sediments.

Capping the contaminated sediments in place, Alternative 7, is least favored due to the significant uncertainty with the effectiveness of this option at protecting human health and the environment. There are many unknowns with how effective a cap will be in reducing bioavailability of contaminants to fish. Physical disturbances, diffusion and advection all can compromise the ability of a cap to perform adequately. In addition, capping is not a proven technology in shallow water. Nationally caps have only been installed at deep water sites, and none of these sites have post-monitoring data to show that they have been effective at reducing writaminant levels in fish. Dredging on the other hand has been shown through post-monitoring data at the Waukegan Harbor site in Illinois to have reduced contaminant levels in fish such that a fish advisory was removed. At the Black River site in Ohio dredging resulted in reduced numbers of tumors in fish. Deposition of cleaner material and biodegradability are not effective at reducing contaminant levels in fish as evidenced by the fish data which clearly shows, that although contaminant levels in the top 6 inches of sediments is declining, contamination in fish tissues is not. If Alternative 7 was seltreted and implemented and then found not to be effective at reducing contaminant levels in fish tissue, U.S. EPA would have to reconsider the remedy and potentially select one of the removal alternatives instead. This, would significantly increase the costs overall, since not only would U.S. EPA have to remove the cap, but also the contaminated sediments.

XI. Selected Remedy

U.S. EPA Region 5 is selecting Alternatives 4, 5 and 6: Hydraulic Modification of the Pine River, Excavation of Sediments, Dewatering and Water Treatment and disposal of contaminated sediments in either a RCRA Subtitle D or C landfill. Alternatives 4, 5 and 6 represent the best balance of the nine criteria. U.S. EPA recognizes that installation of temporary coffer dams may not be implementable in all locations in the St. Louis Impoundment and therefore some of the sediment removal may need to be completed using mechanical or hydraulic dredging (Alternatives 2A or 3A).

Alternative 4 contemplates the use of temporary cofferdams and excavation of sediments. The temporary coffer dams will be placed in the St. Louis Impoundment, water will be pumped from the cofferdam, the sediments will be excavated, a stabilizing/drying agent will be added and wastewater will be treated prior to discharge to the Pine River. The water treatment will be designed to meet surface water discharge requirements and will probably consist of clarification, sand filtration, carbon filters and 1 micron bag filters. During excavation operations monitoring will be conducted to ensure protection of workers and the community. Monitoring of resuspension will be done directly downstream of the excavation operations. Air monitoring will be conducted. After completion of the dredging project sediment samples will be collected to ensure the clean-up standard has been met. The State of Michigan will continue to monitor fish tissue levels.

For a detailed cost estimate of the selected remedy, see Appendix B of this ROD.

Expected Outcomes of the Selected Remedy

U.S. EPA utilized a volume break point analysis and risk reduction analysis to determine a protective and cost effective cleanup goal for total DDT in the Pine River. Table 2.5-1 shows a range of cleanup goals (1, 5, 10 and 100 ppm total DDT) and compares the area, volume of sediment required to be removed, and total DDT mass that would be removed if the goal were met. The average dredging depth is assumed to be 5 feet.

Table 2.5-1 Volume Break Point Analysis

Conc. (ppm)	Area (acres)	Volume (cy)	Mass (lb)
1	65	516,650	538,730
5	32	262,380	534,305
10	31	260,330	533,000
100	20	169,900	529,000

Table 2.5-2 shows the concentration of total DDT that would remain in fish tissue and reduction in risk if a cleanup goal of 1 or 5 ppm total DDT were met.

Table 2.5-2 Post Remedial Risk

	Concentration in Fish	Concentration in Fish	RME Risk	RME Risk
Cleanup Goal	Smallmouth Bass	Carp	Smallmouth Bass	Carp
1 ppm	0.5 ppm	1.0 ppm	1.1E-05	2.3E-05
5 ppm	0.8 ppm	1.7 ppm	1.9E-05	4.1E-05

Removing sediment with DDT at or above 5 ppm, will reduce levels of DDT in fish tissue by over 95% from current levels of 12.5 to 0.8 ppm in Bass and 42.5 to 1.7 ppm in Carp. A 1 ppm cleanup doubles the total volume of sediment to be removed while providing only an additional 0.3 ppm reduction in fish tissue levels (12.2 to 0.5 ppm). Therefore, removing sediment in the Pine River contaminated with 5 ppm DDT and higher, will obtain the maximum reduction of risk to human health and the environment that is practicably achievable at the Site. To attain a 5 ppm level in sediments approximately 260,000 cubic yards of sediments would be removed from the St. Louis Impoundment. The removal action together with the remedial action will accomplish removal of sediment with total DDT above 5 ppm.

XII. Statutory Determinations

This section discusses how the Selected Remedy (Alternatives 4, 5 and 6) satisfies the statutory requirements of CERCLA section 121 (as reflected in the NCP requirements at 40 CFR Section 300.430(f)(5)(ii) and explains the five-year review requirements for the Selected Remedy.

Overall Protection of Human Health and the Environment

Alternative 4 considers removing all sediments at or exceeding 5 ppm total DDT from the St. Louis Impoundment using temporary cofferdams and excavation. Based on the human health risk assessment and ecological risk assessment, removal of sediments at or above 5 ppm will provide protection to human health and the environment because risk associated with the exposure pathways will be substantially reduced. Removal of contaminated sediments are expected to produce a significant decrease in the levels of total DDT in fish tissue, resulting in significantly reducing the possibility of human health effects from consumption of contaminated fish and reproductive effects to fish-eating birds. The second exposure pathway, direct contact with contaminated sediments would also be eliminated by removing sediments at or above 5 ppm. This alternative will meet all the remedial action objectives (RAOs) and will not pose unacceptable short-term risks.

RCRA subtitle D landfills are constructed for the purpose of disposal of municipal solid waste. Construction requirements for bottom liners, leachate collection and monitoring are generally not as stringent as for landfills designed to accept hazardous waste (subtitle C landfills). The determination of how protective disposal in a subtitle D landfill would be will depend on the mobility of the contaminants placed in the landfill and the construction specifications of the landfill. DDT and its congeners, which constitute the principal threat at the Site, are not very mobile. DDT and its congeners prefer to stay bound to organic matter and are hydrophobic. If the landfill is constructed with bottom liners and leachate extraction, it is likely that this option would be protective of human health and the environment. The direct contact exposure pathway would be eliminated with this alternative.

RCRA subtitle C landfills are constructed for the purpose of disposal of industrial hazardous waste. Construction requirements for bottom liners, leachate collection and monitoring are more stringent than for landfills designed to accept municipal waste (subtitle D landfills). The determination of how protective disposal in a subtitle C landfill is will depend on the mobility of the contaminants placed in the landfill and the construction specifications of the landfill. DDT and its congeners, which constitute the principal threat at the Site, are not very mobile. DDT and its congeners prefer to stay bound to organic matter and are hydrophobic. If the landfill is constructed with bottom liners and leachate extraction, it is likely that this option would be protective of human health and the environment. The direct contact exposure pathway would be eliminated with this alternative.

Compliance with ARARs

Excavation and/or dredging activities would comply with the substantive requirements of the Federal Clean Water Act and the Michigan Inland Lakes and Streams Act and State chemical-specific, action-specific, and location-specific ARARs specified in the RI/FS Report. Contaminated sediments were tested by the TCLP (Toxicity Characteristic Leaching Procedure) and determined not to be RCRA characteristic. U.S. EPA will continuously characterize the stockpiled sediments prior to disposal, typically every 200 cubic yards. The contaminated sediments are not considered to be RCRA listed waste because the contamination occurred primarily from the direct discharge of DDT process wastewaters to the Pine River. See 40 CFR Section 261.33(d) comment. Waters from the dewatering process will be treated using Best Available- Technology (BAT) processes in order to comply with the substantive requirements under the Clean Water Act and Part 31, Water Resources Protection, of the Michigan Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA).

Excavation and/or mechanical dredging would comply with action- a location-specific ARARs, and through appropriate management (i.e., storage and disposal) of dredged materials.

During implementation of this alternative reasonable efforts will be made to minimize potential human health and ecological risks, as well as minimize disruption of existing natural processes associated with remediation. Excavation and/or mechanical dredging is not expected to create an unacceptable short-term risk to human health or the environment from resuspension of contaminated sediments based on two sediment excavation projects U.S. EPA has completed. Engineering controls, such as silt curtains and temporary coffer dams would be utilized to minimize concerns with resuspension in conjunction with turbidity monitoring.

Transportation of the waste material will maintain the proper permits and adhere to the applicable standards for proper identification number, reporting and manifest system as established by the U.S. and Michigan Department's of Transportation. This alternative would meet the chemical-specific, action-specific and location-specific requirements set forth in federal and state laws.

Cost Effectiveness

In the Agency's judgment, the Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness." (40 CFR 300.430(f)(1)(ii)(D). This was accomplished by evaluating the "overall effectiveness" of those alternatives that satisfied the threshold criteria (i.e., were both protective of human health and the environmient and ARAR-compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost-effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs and hence represent a reasonable value for the money to be spent.

For this Site, Alternatives 2A, 3A, 4 and 7 were all considered to be cost-effective. The cost of Alternative 7 (capping), although significantly lower than costs for Alternatives 2A, 3A and 4 (see Cost Table on page 23 of this ROD), was not considered to be proportional to overall effectiveness. The long-term effectiveness and permanence of a shallow water cap is uncertain since capping in shallow waters has never been completed. In addition, even at sites where capping was implemented, none of these sites have post-monitoring data to show that they have been effective at reducing contaminant levels in fish. Alternative 7 does not employ any treatment and therefore will not reduce toxicity, mobility, and volume through treatment, and does not provide any additional degree of short-term protectiveness over Alternatives 2A, 3A and 4 since installation of a cap will result in some resuspension of contaminated sediments just as dredging or excavation will.

Alternatives 2A, 3A and 4 are very similar and have similar costs (see Cost Table on page 23 of this ROD). In evaluating the incremental cost-effectiveness of these alternatives, the decisive factors considered were amount of water required to be treated and efficiency at removing sediment. Because Alternative 4 utilizes temporary coffer dams and excavation of sediment, it is anticipated that sediment removal will occur faster than using mechanical or hydraulic dredging and the amount of water that will require treatment is less than for either of the dredging alternatives. Therefore the cost for Alternative 4 is lower ($16.9 million) and represents a better value for the money spent. The cost for the Selected Remedies, Alternatives 4, 5 and 6 ranges from $20.1 - 34.3 million depending on how much of the sediment is disposed in a subtitle C versus subtitle D landfill.

Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

The Selected Remedy represents the maximum extent to which permanent solutions and treatment are practicable at the Site and affords the best balance of tradeoffs as compared to the other alternatives. Alternatives 2A, 3A and 4 are all very similar. The advantage Alternative 4 has over Alternatives 2A and 3A is that with the use of temporary coffer dams the sediments can be excavated which will be faster than dredging and require less water treatment, thereby reducing costs. Alternative 7, capping, does not provide the best balance of tradeoffs because there is too much uncertainty that capping wilt provide long-term effectiveness and permanence and reduction of toxicity, mobility, or volume through treatment. Implementablity is also a problem in the St. Louis Impoundment because water levels are very shallow. The community does not support leaving contaminated sediments in place.

Preference for Treatment as a Principal Element

Remedial actions in which treatment which permanently and significantly reduces the volume, toxicity or mobility of the hazardous substances, pollutants, and contaminants is a principal element, are to be preferred over remedial actions not involving such treatment.

Alternatives 2A, 3A and 4 all employ treatment of the principle threat (DDT-contaminated sediments) with a drying/stabilizing agent. The drying/stabilizing agent will reduce mobility of the DDT in the sediment prior to the sediment being disposed off-Site. Alternative 7, capping, does not employ treatment of sediments and therefore is not preferred over the selected remedy, Alternative 4.

Since the contaminated sediments are not a listed or characteristic waste under RCRA, as discussed in the "Compliance with ARARs" section above, the land disposal restriction for DDT-contaminated soil would not be applicable.

Five-Year Review Requirements

CERCLA section 121(c) requires a five-year review if the remedial action results in hazardous substances remaining on-site above levels that allow for unlimited use and unrestricted exposure. All sediments at and above 5 ppm. total DDT will be removed and it is anticipated there will not be site-related use restrictions on the river after the completion of the remedy. Restrictions on fish consumption, however, will remain in place until it is demonstrated that contaminant levels in fish have reached acceptable levels. Therefore five-year reviews will be required until fish tissue levels reach acceptable levels. The five year reviews for OU2 will be included as part of the five-year reviews -required for OU1.

Therefore five-year reviews will be required until analyses indicate acceptable levels are achieved in fish tissue. The five year reviews for OU2 will be included as part of the five-year reviews required for OU1.

XIII. Documentation of Significant Changes

The Proposed Plan, issued on September 8, 1998 recommended Alternatives 4, 5 and 6. U.S. EPA has made a minor change in that this ROD recognizes that there may be parts of the St. Louis. Impoundment that will require hydraulic or mechanical dredging. The ROD allows U.S. EPA flexibility to use dredging in areas where excavation may not be implernentable.

APPENDIX A

Figure 2-1

Velsicol Chemical Corporation (Pine River) Superfund Site
St. Louis, Michican

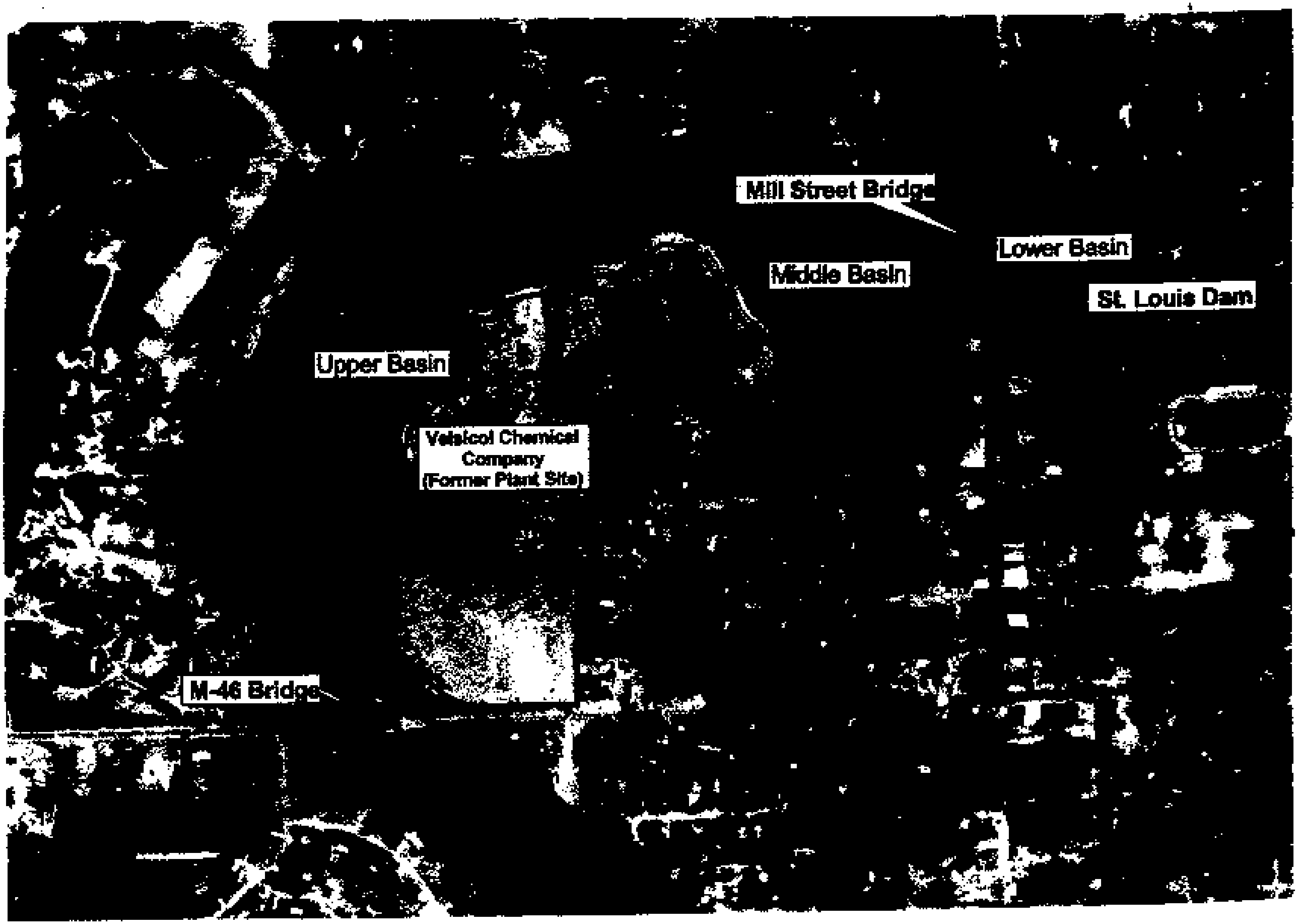


Figure 2-2

Pine River, Chippewa River, Tittabawassee River, Saginaw River and Bay

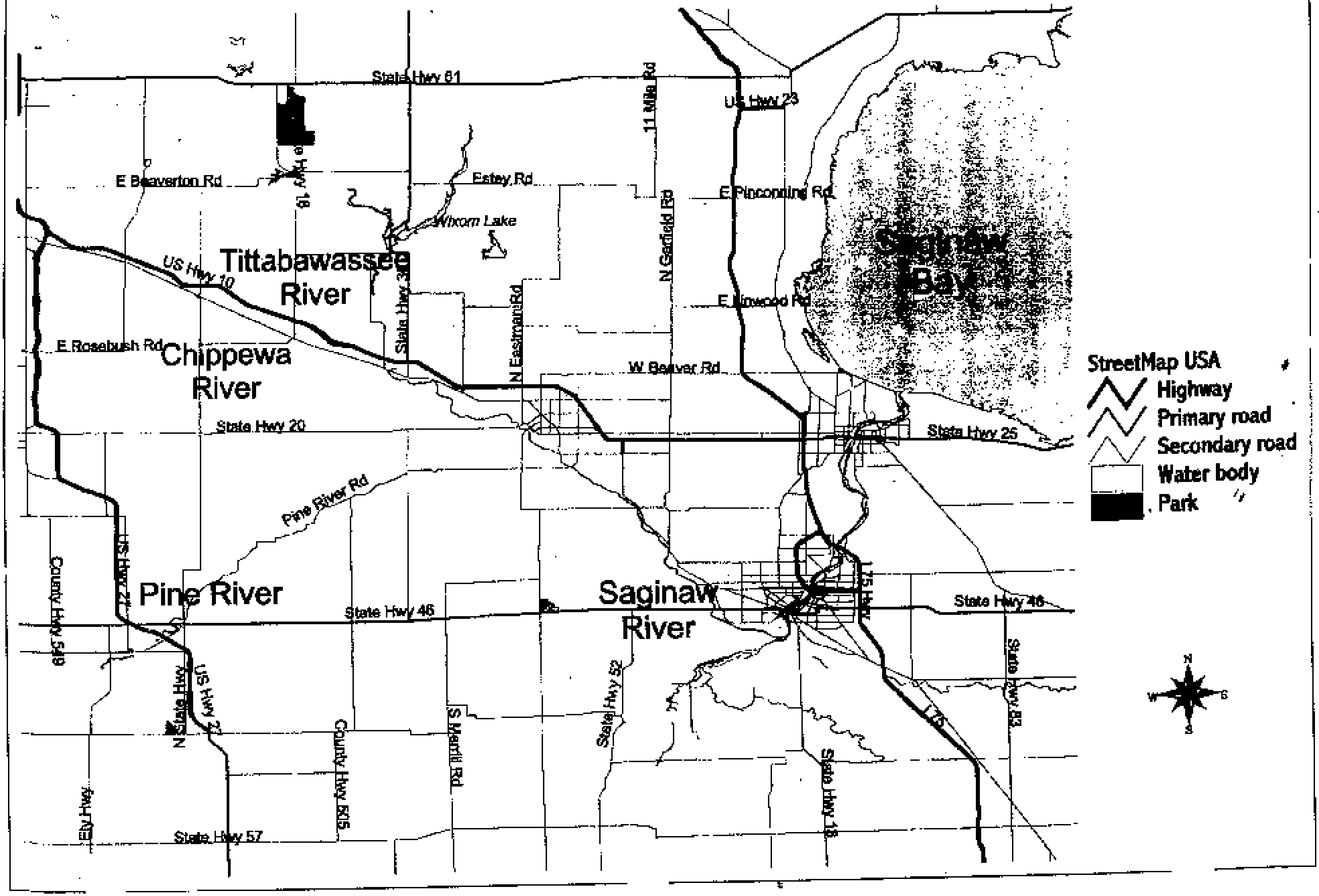
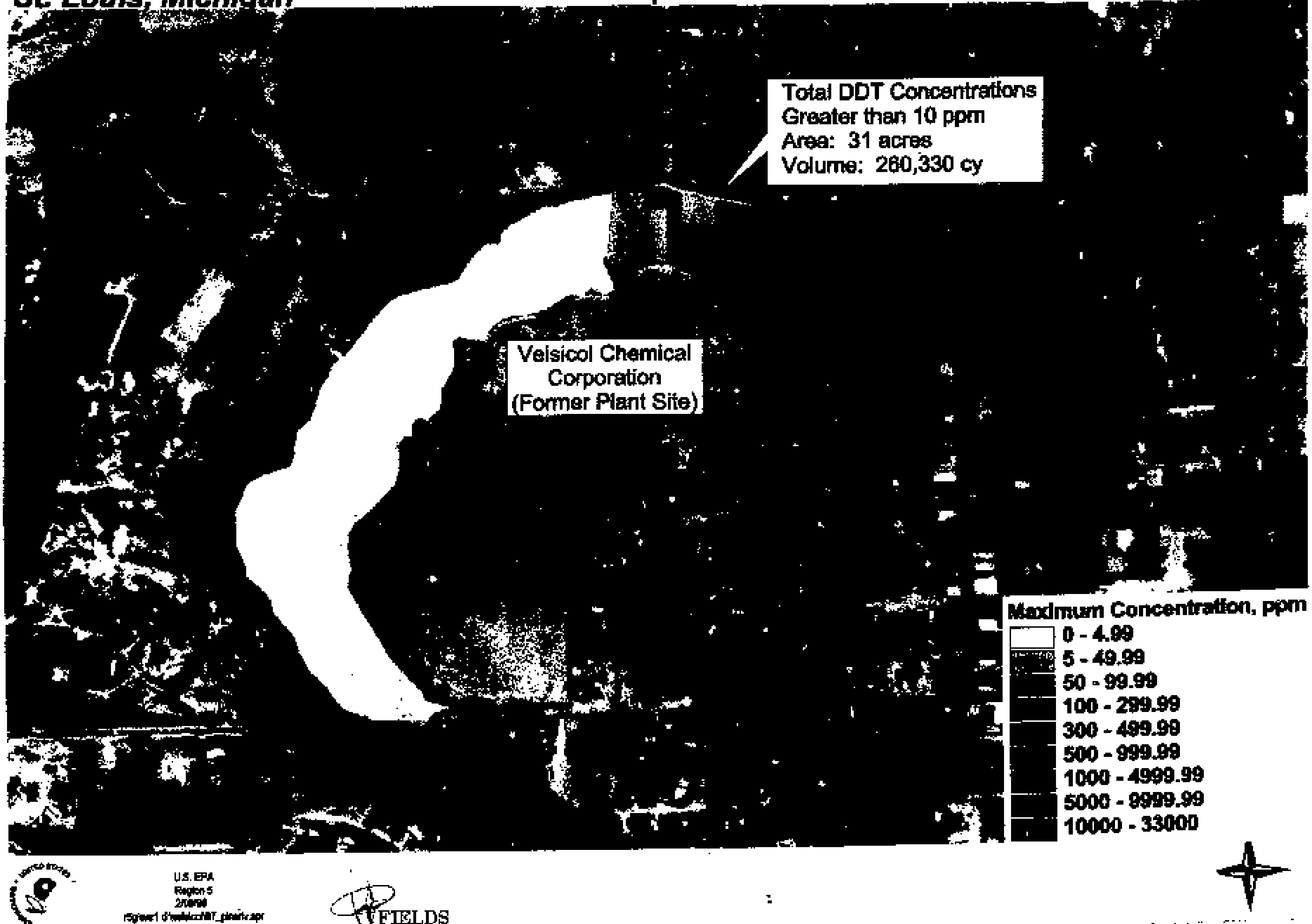


Figure 2-3

Velsicol Chemical Corporation Superfund Site St. Louis, Michigan

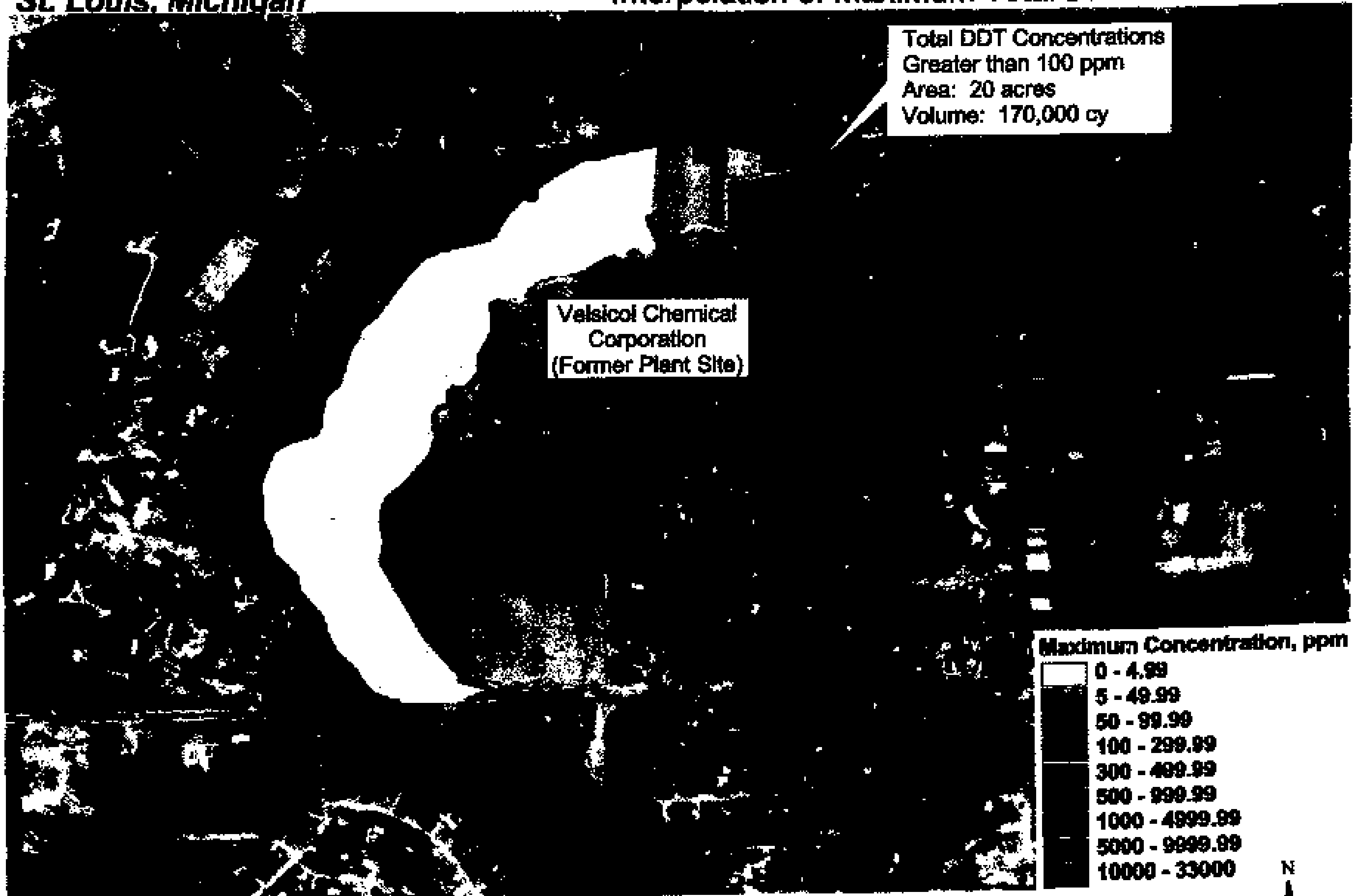
Interpolation of Maximum Total DDT Concentration



Velsicol Chemical Corporation
Superfund Site
St. Louis, Michigan

Figure 2-4

Interpolation of Maximum Total DDT Concentration



U.S. EPA
Region 5

FIELDS

APPENDIX B

APPENDIX B
COST ANALYSIS FOR SEDIMENT REMOVAL ACTION ALTERNATIVE
3 PAGES

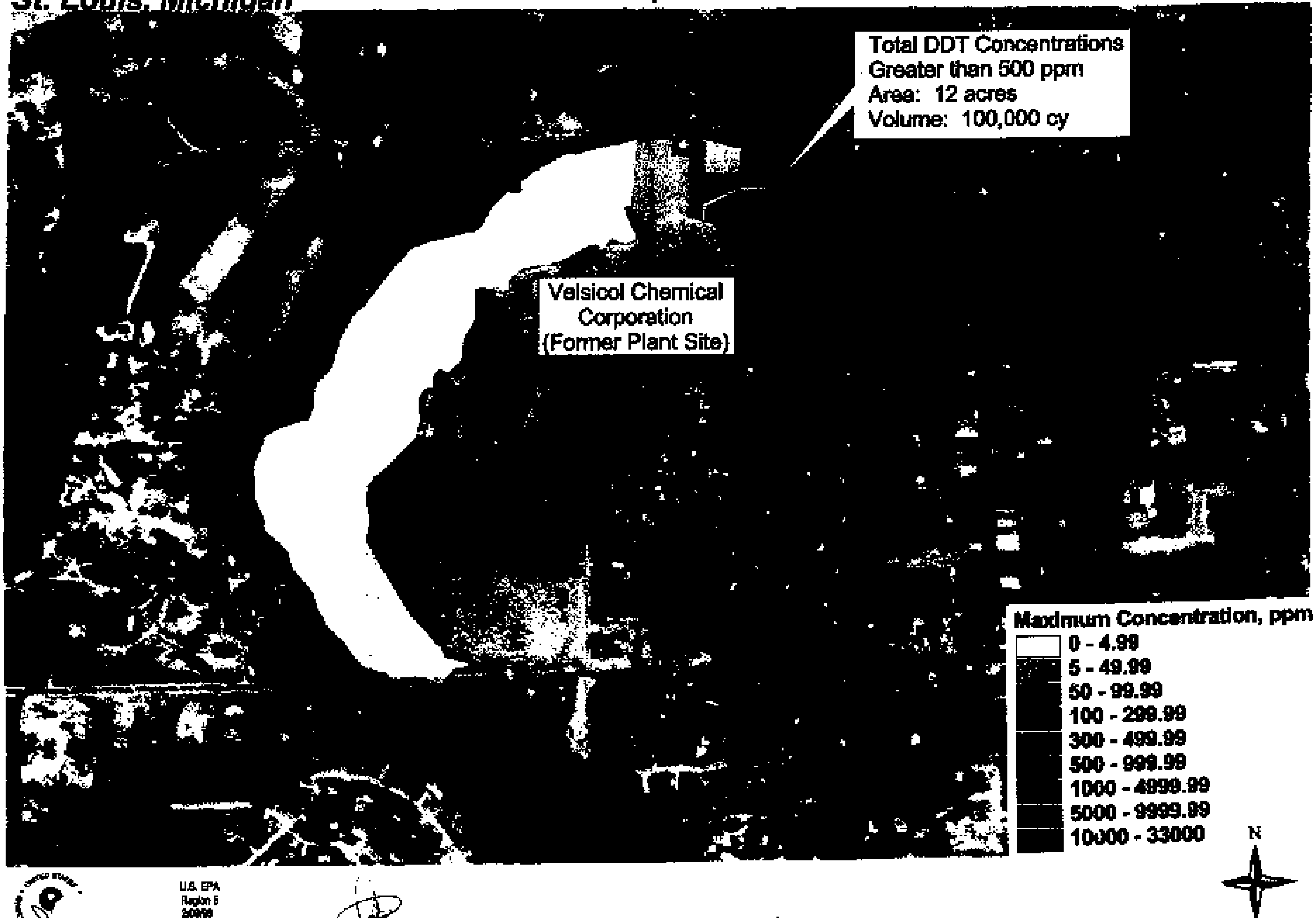
REDACTED

NOT RELEVANT TO THE SELECTION OF THE REMOVAL ACTION

APPENDIX C

Velsicol Chemical Corporation Superfund Site St. Louis, Michigan

Interpolation of Maximum Total DDT Concentration



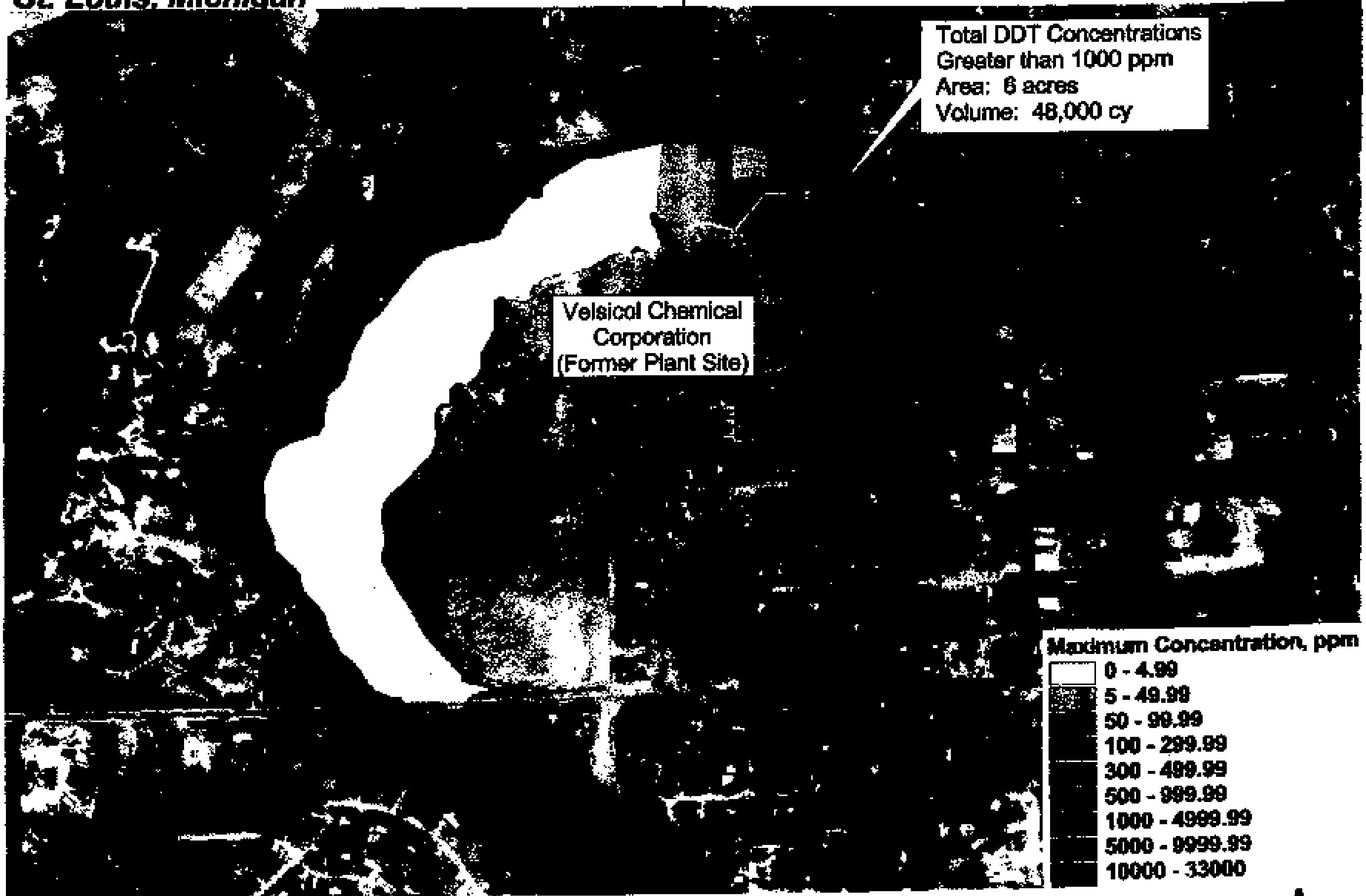
U.S. EPA
Region 5

FIELDS

Velsicol Chemical Corporation
Superfund Site
St. Louis, Michigan

Figure 2-6

Interpolation of Maximum Total DDT Concentration



U.S. EPA
Region 5

FIELDS

Velsicol Chemical Corporation (Pine River) Superfund Site
St. Louis, Michigan

Figure 2-10

1997 USEPA, GLNPO, & MDEQ Sediment Sampling Survey

In July 1997, the USEPA, Region 5, GLNPO and the MDEQ conducted a second sampling in the Pine River and the Impoundment area. The survey was intended to supplement the May 1996 survey and provide additional information as to the nature and extent of the DDT contamination in the Pine River. A total DDT maximum of 32,600 ppm was detected in one sample at depth interval 6 to 42 inches.

N

1997 data (USEPA, GLNPO, MDEQ)
Velsicol Chemical Corporation

U.S. EPA
Region 5

FIELDS

Responsiveness Summary
Velsicol Chemical Superfund Site, St. Louis, Michigan
Record of Decision

I. OVERVIEW

The public participation requirements of CERCLA §113(k)(2)(D)(i-v) and CERCLA §117 have been met during the Record of Decision (ROD) process for the Velsicol Chemical Superfund site (“Site”). Sections 113(k)(2)(B)(iv) and 117(b) of CERCLA require U.S. EPA to respond “...to each of the significant comments, criticisms, and new data submitted in written or oral presentations” on a proposed plan for a remedial action. This Responsiveness Summary addresses those concerns expressed by the public, potentially responsible parties (PRPs), and governmental bodies in written and oral comments received by U.S. EPA regarding the proposed plan.

II. BACKGROUND ON COMMUNITY INVOLVEMENT

U.S. EPA issued a fact sheet/proposed plan in September 1998 prior to the start of the public comment period. A public notice summarizing the Proposed Plan and announcing the public comment period and public meeting was published in the September 9 and 13 editions of the Alma Morning Sun, a local paper with distribution in the communities surrounding the site. In addition, the Proposed Plan was directly mailed to approximately 240 addressees on the Velsicol Chemical mailing list. Personal press contacts with the Alma Morning Sun and Saginaw News resulted in news stories in the editorial columns of both publications prior to the meeting.

An information repository was maintained at the T.A. Cutler Memorial Library, 110 West Saginaw Street, St. Louis, Michigan. Administrative Records were made available to the public for review at the U.S. EPA Region 5 office in Chicago and at the T.A. Cutler Memorial Library in St. Louis.

Community interviews were conducted in St. Louis and Alma, MI between December 15-17, 1997 to provide information for U.S. EPA’s Community Involvement Plan (CIP). Those interviewed included citizens, city officials and members of local environmental groups. The CIP was completed and placed in the repository and administrative records in March, 1998.

The public comment period ran from September 8, 1998, to October 8, 1998. U.S. EPA received no requests for an extension to the 30-day comment period.

U.S. EPA hosted a public meeting in St. Louis on September 16, 1998, to provide background information on the Site, to provide details of the proposed cleanup plan, and to take oral public comments. U.S. EPA answered questions about the Site and the proposed cleanup alternative under consideration. The entire public meeting including formal oral comments on the

Proposed Plan were documented by a court reporter. A verbatim transcript of this public meeting has been placed in the information repository and in the Administrative Record. Written comments were also accepted at this meeting. The meeting was attended by approximately 100 persons, including local residents.

During the comment period, U.S. EPA received written comments from 7 commenters and 5 oral comments concerning the proposed plan. Comments received during the public comment period and the U.S. EPA's responses to those comments are included in this Responsiveness Summary which is a part of the Record of Decision.

III. SUMMARY OF COMMENTS RECEIVED DURING PUBLIC COMMENT PERIOD

U.S. EPA received 5 oral comments at the public meeting which are addressed below.

1. **Comment:** Mr. Mike Bazda asked about the effects that dredging might have on air pollution and wanted to know if air pollution considerations were taken into account when deciding between Alternatives 2A, 3A and 4?

Response: EPA's response action will comply with the Michigan Air Pollution Act. Air pollution is not expected to be a significant exposure route for the community because the sediments will be damp during handling thus reducing the likelihood of blowing. Air monitoring will be conducted during sediment removal to verify the state's air pollution requirements are met.

2. **Comment:** Mr. Dennis Busque asked if EPA had considered killing all the contaminated fish.

Response: Killing the contaminated fish is not part of the proposed cleanup plan for the Pine River. EPA did not consider this during the RI/FS process. If the citizens of St. Louis are interested in pursuing this they should contact the Michigan Department of Environmental Quality.

3. **Comment:** Mr. Harry Vitek stated that he supports the removal of the sediments but feels EPA has not addressed the problem of scouring outside the containment curtain.. He feels EPA has no contingency plan for containing scoured sediments from moving down river.

Response: EPA does not believe that the current sheet pile configuration causes any significant alteration in the river flow or the speed of flow. Therefore, no additional scouring from our activities should result. During the fall EPA conducted turbidity monitoring 3 times a day to verify that resuspension was not occurring, it wasn't. Turbidity monitoring will continue by EPA every day that EPA is on the river doing work. In the upcoming years of work, if there is a potential for the cofferdam configuration to increase flow velocity, and therefore scour, EPA will consider installing a catch basin below the St. Louis dam to collect any resuspended sediments before they move downriver.

4. **Comment:** Dr. Ed. Lorenz, Community Advisory Group (CAG) Chairman, commented that the CAG unanimously supports the removal of the contaminated sediments from the Pine River.

Response: EPA appreciates the support of the CAG.

5. **Comment:** Ms. Tara Blanford wanted to know if the kiln dust that will be mixed with the sediment to dry it out is more toxic than DDT and if it will blow when EPA is mixing it?

Response: Kiln dust would only be toxic if it contained contaminants such as heavy metals. EPA will ensure that the kiln dust is not toxic by having it sampled before it is shipped to the site. During the mixing operations it is likely some kiln dust will blow off site. EPA will be taking precautions to keep blowing to a minimum, such as housing the kiln dust in a silo and using a tremie pipe or similar application method to apply it to the sediments.

U.S. EPA received comments from seven commenters during the public comment period which are addressed below.

6. Dr. Eugene Kenaga submitted seven comments that were printed in the October 4, 1998 Midland Daily News. EPA saw the article and responded to Dr. Kenaga with a letter. Dr. Kenaga clipped the article and submitted it to EPA during the public comment period. EPA's response is re-printed below in its entirety and summarizes Dr. Kenaga's comments.

October 16, 1998

Dr. Eugene Kenaga
President, Little Forks Conservancy
1584 E. Pine River Road
Midland, Michigan 48640

Dear Dr. Kenaga,

A co-worker of mine has family that lives in Midland. He passed on to me the Sunday, October 4,1998 Midland Daily News *FORUM* column entitled *Questions on Pine River cleanup need answers* (see attached). I am the U.S. EPA project manager for the Velsicol site in St. Louis, Michigan which includes cleanup of the Pine River. I am happy to answer your questions posed in the Midland Daily news and I encourage you to call me if you have any further questions at 1-800-621-8431 extension 3-6576 or direct dial at (312)353-6576. I am also available to meet with you and any other concerned citizens about the project. You are also invited to attend monthly .Community Advisory Group (CAG) meetings on the third Wednesday of each month in St.

Louis. Please contact Dr. Ed Lorenz for more information about the CAG at (517) 463-7203.

For the sake of brevity, I have transcribed segments of your questions, the full text is attached to the end of this letter. Here are my responses to your questions:

Question 1: "Why, after 20 plus years of little or no action are EPA and DEQ trying to clean up this river site?"

Response: EPA and the State of Michigan (MDEQ) settled Velsicol's liability for the main plant site and contamination in the Pine River in 1982. The 1982 agreement required Velsicol to close the main plant site by constructing a slurry wall around the entire 50 acre former facility and place a clay cap on top. The purpose of this was to interrupt contamination migration from the site to the Pine River. Velsicol was not required to do any cleanup work on the river in 19PI, and received a covenant not to sue from U.S. EPA and the State. This means that Velsicol wou'd have no finther legal obligation to clean up the river. When this agreement was made, in 1982, dredging of hazardous waste was not commonly done, and hazardous waste dredging technologies were not fully developed. Today, hazardous waste dredging is common, and the technology necessary to ensure safe dredging operations has been developed. So, in 1995, when MDEQ fish monitoring discovered that contaminant levels in Pine River fish had doubled since the last time they collected fish in 1989, the Agencies became concerned that additional contamination was entering the Pine River from the main plant site. In 1996, Velsicol reassessed the slurry wall and clay cap constructed on the main plant site to see if it was the source of additional contamination to the Pine River. The results showed that the slurry wall is effectively keeping any additional contamination from reaching the Pine River, however Velsicol discovered that the clay cap is leaking, allowing rain water to enter the slurry wall and cap system. This accumulated rain water is pumped out routinely by Velsicol and taken to a pretreatment facility near Detroit.

At the same time Velsicol was re-assessing the cap and slurry wall, U.S. EPA and MDEQ decided to take more sediment samples from the Pine River, to see if contaminant levels in sediments have changed since 1982. The results showed that contaminant levels in the top 6 inches have decreased since 1982, and contaminant levels below 6 inches are similar to 1982 level, very high. More sediment samples and more fish tissue samples were collected by U.S. EPA and MDEQ in 1997. This data confirmed that levels in fish were still highcr than in 1989. Our conclusion was that although there did not appear to be any new sources of contamination to the Pine River, the fish were getting more contamination and storing it. in their tissues. Why this is happening is explained in EPA's response to Comment #12-5.

So EPA decided it should re-consider the decision in 1982 to leave contaminated sediments in the Pine River. With hazardous waste dredging technologies available there was no reason not to go forward with a cleanup. Therefore, U.S. EPA completed a thorough study of fish and sediment contamination in the Pine River and evaluated cleanap alternatives in a report called the *Final Streamlined Remedial Investigation/Feasibility Study Report dated August*, 1998. Several copies are located at the T.A. Cutler Memorial Library in St. Louis for anyone to review. U.S. EPA proposed a cleanup that would remove all sediments above 5 ppm total DDT from the Pine River. A public meeting was held in St. Louis to discuss the proposed plan on September 16, 1998.

The 1997 sediment sampling confirmed that there was a “hot spot,” an area where contaminant concentrations exceeded 3,000 pprn total DDT. For this area U.S. EPA proposed an emergency removal action, which allowed U.S. EPA to start work faster when levels of contamination are documented to be extremely high. This work began on June 8, 1998.

All of this work was coordinated with the community through the Community Advisory Group (CAG) which meets once a month in St. Louis. The CAG has a representative member from Midland.

Question 2: “Nothing was said at the meeting about residues at the site concerning other chemicals such as PBB, possibly more persistent than DDT and DDE, still in the Pine River, or of HBB and TRIS made by Michigan Chemical Co. in the past.”

Response: U.S. EPA and MDEQ focused on contamination in fish-tissue to guide us in setting cleanup levels for sediments. This is because risk at the site is associated with eating contaminated fish. Our goal is to clean up fish, to do this EPA has to remove the sediments. Chemicals detected in fish in 1997 above the detection limit were mercury, DDT and its metabolites, chlordane congeners, PBB, hexachlorobenzene and octachlorostyrene. The DDT concentration in most of the fish collected exceeded the Michigan Department of Community Health (MDCH) Level of Concern of 5 ppm total DDT (maximum level in a carp filet was 90 ppm). PBB was not detected in carp, but was found at low levels in smallmouth bass (maximum concentration 0.3 ppm). The mercury and chlordane concentrations did not exceed the MDCH Levels of Concern. MDCH has no official Level of Concern for the other chemicals detected. So the chemical of most concern found in fish was DDT and its metabolites (DDD and DDE). Therefore EPA focused on total DDT in sediments.

In addition, U.S. EPA’s analysis of sediment data shows that to achieve the cleanup goal of 5 ppm total DDT in the area to be dredged all sediments would need to be removed (approximately 260,000 cubic yards). This would require an estimated average dredging depth of 5 feet to the river bottom, which is clay. Since all sediment will be removed, all other contaminants of concern would be removed also. The clay will then be sampled to ensure the cleanup goal is attained. In addition to total DDT, the confirmation samples will also be. analyzed for PBB, HBB and TRIS,

Question 3: “The company that did EPA’s dredging of the Fox River at Manistique (WI) may be doing the dredging of the Pine River. Is it? According to the Fox River Group, PCB’s increased 5-fold in the sediments after dredging at Manistique. The cost over-run there ballooned to over $22 million after an original estimate of $4-6 million and is still not done. Is this same thing going to happen because of the Pine River dredging “remedial” action?"

Response: For clarification, EPA is currently hydraulically dredging the Manistique River/Harbor in Manistique, Michigan. The Fox River is also a contaminated sediment site EPA is considering cleaning up located in Appleton/Green Bay, Wisconsin. The company that is doing the dredging at the Manistique River/Harbor site will not be doing the sediment removal at the Pine River site in St. Louis, Michigan. Regarding the dredging project at Manistique, Michigan, U.S. EPA considers this project to be a success. U.S. EPA has documented a 40-fold reduction of PCB contaminant concentrations in areas where tlie dredging is complete.

The information from the Fox River Group regarding increases in PCB contamination during dredging refers to sampling of areas that were not completely dredged by EPA. However, as stated above, areas that have been completely dredged by U.S. EPA have shown a 40-fold reduction of PCB concentrations.

U.S. EPA’s Action Memorandum dated September 10, 1996 estimates the cost of the dredging at Manistique River/Harbor to be $15 million. U.S. EPA had estimated a partial cleanup of the River/Harbor to be $6 million. Currently U.S. EPA is estimating the total cost of the project will be about $30 million and will be complete in the fall, 1999. The increase in the cost estimate was due to unknown sediment conditions, such as significant amounts of rock and slab wood which slowed down the rate that contaminated sediments could be removed.

It is possible that the cost estimate for the Pine River sediment removal project will be greater or lesser than the estimated $20 - 34 million dollars. Cost estimates are just that, estimates. Actual site conditions can significantly alter cost estimates.

Question 4: “What assurances do we have that melt from snow or other floods will not overrun cofferdams within the remedial sites. Will you be able to treat the water successfully or have the capacity when the flow increases or sediment increases?”

Response: The cofferdams U.S. EPA is installing are made of sheet pile. It is very sturdy and interlocks to form water tight seals. The sheet pile is driven down through the sediment ten feet into the clay bottom of the river and is braced on the inside and outside for additional support. It is very unlikely that snow melt or other floods would overrun the sheet pile. if there was a flood and the containmea area was flooded then EPA would shut down operations until flood waters subsided outside of the cofferdam. Flood waters remaining inside the cofferdam would be pumped. to the treatment plant EPA will build on Velsicol's property and treated to State standards before being discharged to the Pine River.

Question 5: “The EPA judgment of successful remediation seems to come from the amount of material removed from the Superfund Site, not upon how much pollution and disturbances will result down river. Is this the only correct way to assess cleanup?”

Response: U.S. EPA and MDEQ do not expect there to be any significant pollution or disturbances down river from this sediment removal project. A silt curtain has been installed around the sheet pile. Turbidity monitoring in the river is conducted several times a day to ensure that no significant releases of sediments occur downriver. The no consumption advisory for all species of fish is in effect for the portion of the Pine River that flows through Midland. Cleaning up the contaminated sediments in St. Louis is expected to result in fish that will someday be clean enough to eat. This will benefit Midland as well as St. Louis and all other towns on the Pine River that are subject to the fish advisory. The cleanup benefit to the fish and all people and animals that live along the river far outweighs the risks from the small amount of re-suspended sediment. To leave the contaminated sediments in place and vulnerable to natural disasters pose more risks to the St. Louis and downstrearr communities.

Question 6: MDEQ has a warning not to eat fish from the Pine River. There is evidence that the Pine River at Midland has recovered its invertebrate and fish populations now many years after the Michigan Chemical Co. episode. What assurances do we have that the persistent sediment or soluble residue in the remedial action that could come down the Pine River will not reverse this recovery?

Response: This questions is similar to Question 5. The only thing I would add is that DDT, DDD and DDE are hydrophobic, meaning they do not solubilize easily in water. In fact, water samples taken in the St. Louis Impoundment show no detection of DDT, DDD or DDE. These chemicals prefer to stay in the sediments and will generally not partition into water.

Question 7: I pump water from the Pine River to water my lawn and garden What assurance do I have that eating these vegetables is safe or that I will not build up toxic residues in the soil from this practice?

Response: This question is similar to Question 6. There are no detectable levels of contaminants in water from the Pine River. Therefore irrigating your lawn and crops is safe. If you would like to discuss this concern further with the Michigan Department of Community Health (MDCH) you may contact Brendan Boyle at (517)335-8138.

In closing, the proposed sediment removal project has received approval from U.S. EPA, MDEQ, Micnigan Department of Community Health (MDCH), and the Community Advisory Group (CAG). U.S. EPA consults continuously with these groups on the progress being made at the site. U.S. EPA is taking every reasonable precaution to protect our employees, contractors, the community and downriver communities from exposure to contaminated sediments during the project. I encourage you to call me directly with any other questions or concerns you may have regarding this project.

Sincerely,

Beth Reiner
Remedial Project Manager

cc: Kim Sakowski, MDEQ
Brendan Boyle, MDCH
Ed Lorenz, CAG Chairman
Sam Borries, EPA OSC
Stuart Hill, EPA CIC
Midland Daily News

7. Mr. Frederick L. Brown submitted 5 comments as follows:

Comment #7-1: No explanation for the significant increase of DDT in fish has been offered. Is them some other source of contamination to the river?

Response: Pages 24-27 of the RI/FS summarizes the fish data and discusses possible reasons for why the concentrations in fish after 1989 are significantly higher than pre- 1989. Fish tissue data is difficult to compare due to variabilities in the data (weight, age, %fat and number of samples collected). The average weight of fish collected after 1989 increased, and sometimes so did the average %fat. This would account for some of the reason fish tissue levels of total DDT are greater post-1989, since larger, older fish will bioaccumulate more DDT. Also, the 1997 data analyzed for all 6 congeners of total DDT, all previous years had only analyzed for 3 congeners (see Table 2.2-10, page 25 in the RI/FS Report). EPA's conclusion is that if fish tissue data could be normalized it would show that levels have been fairly constant over time.

When the 1994 fish tissue results came out, both EPA and MDEQ were concerned that the main plant site might be leaking additional contamination to the Pine River. Velsicol conducted a thorough study of the slurry wall and cap system with EPA/MDEQ oversight and found that the cap was leaking but the wall appears to be intact. Therefore, EPA and MDEQ concluded that the main plant site is not leaking additional contamination into the Pine River. MDEQ also went through its records looking for other industries or disposal sites along the river that may have contributed DDT to the river. None were found. So the answer is no, EPA and MDEQ have not found any additional sources of DDT contamination to the Pine River in the area of the Velsicol site.

Comment #7-2: What about contaminants other than DDT?

Response: A similar question was asked by Dr. Kenaga, please see our response to his Question #2.

Comment #7-3: What about the potential for downstream releases? Construction of coffer dams will restrict the river channel, increase flow velocity and cause scouring and resuspension. This will also be affected by spring run-off and/or high rain fall.

Response: The sheet pile which is currently in the river does not obstruct the rivers natural channel and therefore there should be no increase in flow or scour. However, EPA is taking precautions to ensure that significant releases of resuspended sediments do not move down river. A silt curtain has been installed around the sheet pile. During construction activities, turbidity monitoring in the river is conducted three times a day to verify that no significant releases of sediments occur downriver. EPA does not believe that the current sheet pile configuration causes any significant alteration in the river flow or the speed of flow. Therefore, no additional scouring from our activities should result. When the remedial portion of the work begins the coffer dams may be reconfigured and if the reconfiguration may increase flow velocity, and therefore scour, EPA will consider installing a catch basin below the St. Louis dam to collect Lay resuspended sediments before they move downriver.

Comment #74: Monitoring of impacts of downstream releases. Deposition of released sediment should be mapped, water column concentration and wildlife bio-uptake of all contaminants should be determined and large scale agricultural irrigation should be monitored. Downstream aquatic population dynamics should be determined before and after dredging.

Response: In 1996 MDEQ collected sediment samples between the St. Louis dam and the confluence with the Chippewa River. MDEQ had difficulty finding locations below the St. Louis dam where there was enough sediment deposition to obtain a sample. Since there aren't many depositional areas below the dam it would be difficult to map deposition of any released sediment. In addition, turbidity monitoring completed by EPA during the fall of 1998 indicated that turbidity levels did not increase during construction activities such as installation of the silt curtain and sheet pile. Data indicates that the main exposure route to wildlife from contamination in the Pine River is from fish consumption. Therefore, addressing the source of contamination to fish should reduce the bio-uptake of contaminants to wildlife. If you would like to discuss this concern further with the Michigan Department of Community Health (MDCH) you may contact Brendan Boyle at (517)335-8138.

Regarding irrigation, the Pine River fish monitoring data show that downstream fish have accumulated significant concentrations of DDTr (sum of DDT, DDD and DDE) prior to clean up activities. Since depositional zones are scarce below the St. Louis dam, the primary route of exposure to the downstream fish is probably direct uptake from the water colurrin. Based on the 1997 carp fillet data, the calculated downstream water concentration is approximately 0.2 ppb pp-DDTr (sum of the para, para-DDTr - see EPA's response to Comment #12-5 for calculations). In terms of irrigation use, this is equivalent to 20.6 mg pp-DDTr/acre-inch irrigation water (0.2 ug/l x 102,790 l/acre-inch). Incorporated into the top 6 inches of soil, this results in 28 ppt ppDDTr in soil for every inch of irrigation water applied (20.6 mg/acre ÷ 746,500 kg/acre-furrow slice). For a quick benchmark comparison, the soil level of concern for DDT in The Netherlands is 4 ppm. 4 ppm is 143,000 times greater than 28 ppt. Farmers would have to apply 12,000 feet of irrigation water before their fields would aceumulate DDT to the Netherlands level of concern (this would be more than 2 miles of irrigation water). Note: this calculation does not account for degradation or volatilization of DDT after it is in the soil, which would further increase the amount of irrigation water needed to reach soil levels of concern.

Even low levels of DDT in agricultural soil could be of concern if plants bioconcentrate DDT into their tissues to levels much greater than in soil (as occurs between fish and surface water). However, this is not the case. Although plants can absorb DDT from the soil, the levels in plants remain low. For example, soybeans and ryegrass accumulate DDT in their above-ground parts to concentrations only 14 to 93 times higher, respectively, than in the solutions bathing the roots (cited in Polder, et al. 1995), compared with 1.5 million times greater concentrations in fish lipids compared with surface water. Applying these relationships to irrigation water with 0.2 ppb DDTr, crops would accumulate 3 to 19 ppb DDTr in the above-ground tissues (0.2 x 14 or 93). As a rough comparison, this is less than 4 % of the FDA limit of 5 ppm. Even for a worse case scenario in which downstream surface water concentrations reach the solubility limit of DDT of 1.2 ppb (Matsumura 1985), the FDA level would not be exceeded by crops grown entirely with river water (17 ppb to 1 ppm).

In conclusion, the risks associated with crops grown with Pine River irrigation water are minor. Monitoring efforts should therefore focus on the much greater potential risks associated with river fish.

The suggestion to monitor aquatic population dynamics does not specify the type of organism. The logical choices would be aquatic plants (macrophytes and/or algae), benthic invertebrates, or fish. Each is discussed below in terms of susceptibility and use of the monitoring data for decision-making purposes.

Aquatic plants would not be suitable because the toxicity of DDTr to plants is very low. Also, plants are not an important exposure pathway for accumulation of DDTr by other aquatic organisms (Matsumura 1985). They are not considered further.

Most of the benthic (bottom-dwelling) invertebrates are insects, so they are expected to be susceptible to DDTr since it was marketed as an insecticide (e.g., Edwards, et al. 1964); however, several studies have shown evolution of resistance to DDTr by benthic invertebrates in chronically contaminated waterways (Webber, et al. 1989 and refs.). Since downstream benthic communities have been chronically exposed for several decades to surface water DDTr dissolved from the St. Louis impoundment, they probably have evolved higher levels of resistance compared with unexposed communities. Downstream benthic communities may be unlikely to respond sensitively to changes in surface water DDTr in the Pine River. Another complication is that base-line benthic population/community data are lacking for the Pine River. This is important because benthic measurements vary by season and by year. A single set of data collected in the spring before the beginning of the next construction season would not provide a suitable base-line for evaluating benthic changes during remedial activities. There will be no reliable methods for determining whether observed trends in the benthic surveys are related to tile site activities (increased contaminant loading and/or turbidity), or due to natural seasonal or annual fluctuations (including effects of weather). The only reliable determination will be in the event that downstream benthos is catastrophically impacted, that is, if the downstream community is virtually eliminated. Trends other than catastrophic will likely not be attributable solely to remedial activities, and so will be of limited use for decision-making. Benthic monitoring is therefore recommended only with the understanding that it will provide limited information - i.e., whether catastrophic impacts on downstream communities have occurred. It will be unreliable for less severe impacts because of the lack of appropriate long-term baseline data and the possible evolution of DDT resistance by benthos over the past several decades of chronic exposure. EPA and MDEQ are discussing conducting some benthic; monitoring but no decision has been made yet.

Fish also are unlikely to be poisoned outright by DDT releases, as evidenced by the survival of carp and other species within the St. Louis impoundment. Monitoring fish populations will therefore not be an appropriately sensitive endpoint for detecting adverse downstream impacts.

The recommended approach for monitoring for downstream releases is to continue the fish contaminant surveys performed by the state. This has several advantages. An important one is that historical baseline data exist, so there is a good foundation for comparison with the remedial monitoring data. Another advantage is it measures the parameter most directly associated with both human health and ecological risks - the concentration of DDTr in fish. EPA recommends collection of carp and analysis of fillets so that the data is directly comparable to previous monitoring. The data should be lipid-normalized for the sum of pp-DDT, pp-DDD and pp-DDE. Since downstream fish appear to be exposed primarily through direct water column partitioning, this should provide a sensitive measure of possible releases from the site to downstream reaches.

> **Comment #7-5:** The cleanup standard of 5 ppm. total DDT in sediments is based on risk to adults via fish consumption and reproductive problems in fish eating birds. Possible endocrine and neurological impacts were mentioned but no data presented, why? Failure to consider exposure to children and fetal dose caused by exposure via mother's body burden of contaminants and breast feeding were not considered and should have been.

Response: As was stated in the RI/FS report, the toxicity information needed to look at endocrine and neurological impacts is not complete. It is certainly agreed that fetal exposures and maternal body burden are important considerations, and it would have been preferable to assess these endpoints. However, no toxicity factors for these endpoints exist at this time. EPA therefore looked at all endpoints EPA could, i.e. those that are in IRIS. Short of deriving a new, non-peer reviewed toxicity factor, this type of assessment is not possible at this time.

Risk assessments should be performed with defensible data. Defensible data have been developed for assessing the reproductive effects of DDT in fish-eating birds (which is a type of endocrine, disruption effect). Although other effects, such as behavioral, have been reported in some wildlife studies, the levels associated with unacceptable risk are not well characterized. Unless the dose levels associated with unacceptable risk to wildlife are known, there is no way to use the results of food-chain modeling to guide risk management decisions. Such levels are known for bird reproduction, but are not adequately known for behavioral or other effects in wildlife (other than direct lethality, which occurs in mammals and birds at exposures much higher than that at this site).

8. C.W. Dunbar submitted one comment:

> **Comment #8-1:** Alternative 1 (No Action) should be the selected alternative. In the FS it is obvious that the purpose of the work is to remove DDT from the fish in the Pine River. Unless you remove every trace of DDT from the river, fish will continue to build up P)T content in their bodies. It is physically impossible to remove every trace of DDT from the river and therefore this project is an exercise in fiatility.

Response: EPA calculated the levels of contamination in fish tissue if 5 ppm total DDT and 1 ppm total DDT were left behind in sediments in the St. Louis Impoundment (see page 80-81 in the RI/FS Report). These calculations indicate that if sediments mere cleaned up to 5 ppm, total DDT or less carp fish tissue levels would be 1.7 ppm total DDT and smallmouth bass fish tissue levels would be 0.8 pprn total DDT. These levels result in an acceptable risk to human health and a significant improvement from levels currently seen in fish tissue. Although the river will never be returned to pristine conditions, EPA believes the cost of the response action is worth returning the Pine River to a place that is safe for humans and wildlife.

9. Mr. Rick McKenna wrote in one comment:

> **Comment #9-1:** As a sportsman and an environmentalist I feel the EPA and MDEQ have a removal plan that is very adequate. The Velsicol site is not going to go away by itself. So I say we go ahead with this well thought out solution and get something done.

Response: Thank you for you comment supporting the cleanup plan.

10. Mr. Bob Veenstra wrote in eleven comments:

> **Comment #10-1:** For locations where the cofferdam is not adjacent to the former Velsicol property, it is not clear how water and sediments will be transferred to the Velsicol property. Will construction equipment be stationed on property other than that which is owned by Velsicol? If so, what type of access, security and environmental monitoring will be done at this location?

Response: EPA realizes that the use of cofferdams and dry excavation may not be the best way to remove all sediment from the St. Louis Impoundment which is why the ROD states that dredging technologies, either mechanical or hydraulic, may be used for some of the removal. The details of how water and sediments will be transferred to the Velsicol property have not been completed yet, this will happen during the remedial design phase of the project (after the ROD is signed). Property other than Velsicol's may be used for storage of equipment, but this will be determined during the remedial design. EPA also knows that designs can and often are modified when the actual field work starts. If other properties are used the same type of security, such as fencing, would be used as is used at the Velsicol property.

> **Comment #10-2:** To place the cofferdams, plans have been discussed to lower the water level in the St. Louis Impoundment which could expose contaminated sediments. What precautions will be taken to address the public health exposure potentials of this action?

Response: EPA did propose lowering water levels in the St. Louis Impoundment to facilitate the installation of the sheet pile. This idea was presented to the Community Advisory Group (CAG). Many concerns were raised similar to the one in your comment. EPA heard the communities concerns and changed the plan for installation of the sheet pile. Instead of lowering the water levels, EPA brought in sectional barges and actually raised the water level a little so the barges wouldn't ground out. This method was successful and there seems to be no reason why EPA could not use this method for any additional installation of sheet pile.

> **Comment #10-3:** The process of excavating sediment, placing it on trucks, transporting it to a pad, mixing it with cement kiln dust, reloading it onto trucks and taking it off-site for disposal requires a significant amount of material handling (and equipment manpower). A common rule in construction and material handling is that costs go up significantly every time something is picked up and moved. Other methods, which were evaluated, particularly hydraulic dredging, would require significantly less handling, manpower, and equipment to reach the same endpoint.

Response: EPA is proposing to mix the cement kiln dust in-situ, then excavate the sediment on to trucks, unload the stabilized sediment onto a staging pad for up to three days and then load on to trucks for disposal. This would not be significantly different than hydraulic dredging. In hydraulic dredging the slurry would go to a settling basin where a polymer would be added. The slurry would then be pumped to belt filter presses for dewatering. After pressing the sludge would be moved to a staging pad and then loaded for disposal. EPA completed detailed cost estimates for hydraulic dredging, mechanical dredging and excavation (see Appendix B of the RI/FS Report). Hydraulic dredging was estimated to cost approximately $5 million dollars more than excavation. This is because hydraulic dredging creates the most wastewater that has to be treated before discharge back to the Pine River. Also hydraulic dredging is not estimated to be able to remove sediment as fast as excavation, therefore adding costs for additional time to rent equipment and pay contractors. However, EPA realizes that all areas of the St. Louis Impoundment may not be able to be excavated and therefore dredging, either mechanical or hydraulically, may be considered for some parts of the St. Louis Impoundment.

> **Comment #10-4:** The primary technical reason that hydraulic dredging was not selected appears to be the concern that it would generate significant amount of water to be treated. However, if the dredge were appropriately sized the water generated would be well within the operational capacity of the water treatment system being designed for the emergency removal action. This concern does not appear to be valid if the dredge were appropriately sized.

Response: Water treatment is a major concern for EPA with this project because the state requires that EPA meet a stringent discharge standard before EPA can discharge any water back to the Pine River. EPA has completed treatability studies on die sediment and water whir , shows that the sediment is very fine, which makes it hard to settle in a clarifier and will be a major hurdle for meeting the discharge standard because DDT sticks to the sediment, so virtually all particles must be removed from the water in order for us to meet the discharge 5tandard. The other hurdle with hydraulic dredging is that it does not remove sediment as fast as excavation, which makes it more costly than excavation. EPA has experience with hydraulic dredging and is aware that there are pluses and minuses, as with any technology. For this particular site, excavation appears to be the most cost effective way to address contamination in the St. Louis Impoundment. Of course if excavation is not possible in some areas of the St. Louis Impoundment, dredging will be used.

> **Comment #10-5:** The use of cement kiln dust poses several concerns, such as it may be contaminated with heavy metals, it is susceptible to wind dispersion and thus significant exposures to the local population. Appropriate monitoring programs must be established to ensure safe handling of the material. Also the mixing method of using the buckets of excavators could result in significant amounts of windborne kiln dust to be released and offers little control over dosage or the cost effective use of this material.

Response: Cement kiln dust is a commonly used stabilizing agent. You are correct that there can be problems with it blowing when it is stored or when it is being mixed. EPA will be taking precautions to minimize blowing, such as storing it in a silo and applying it with a tremie pipe or similar application method. Also, the kiln dust EPA purchases will be tested for heavy metals to ensure it is not contaminated above regulatory limits. EPA will be implementing an air monitoring program which meets the requirements of the state of Michigan.

> **Comment #10-6:** In terms of short-term risks to the community and on-site workers, as well as technical implernentability, the recommended alternative appears to be less desirable than other alternatives reviewed.

Response: EPA disagrees. EPA's expectation is that excavation of sediments with the use of cofferdams will remove the contaminated sediments faster and more efficiently than the dredging technologies. This saves time and money and results in less likelihood of the community being exposed, and less likelihood of significant releases moving down river. EPA does not believe that risks to the community are any greater from Alternative 4 than from the other alternatives evaluated. On-site workers will use adequate personal protective equipment to protect themselves from exposure.

> **Comment #10-7:** The cost analysis for the hydraulic dredging alternative was developed by extrapolating costs from EPA's experience at Manistique, Michigan. The cost is therefore erroneously high because the equipment and technical approach used at Manistique would be inappropriate for use at the Velsicol site. A properly designed hydraulic dredging program would be much less costly than EPA's estimate for Alternative 2A.

Response: EPA did use its experience at the Manistique, MI project to estimate costs for a dredging project in the Pine River. However, costs were not just extrapolated, costs from the Manistique project were used as a guideline to estimate costs for the Pine River project. This certainly is appropriate and EPA does not believe our cost estimate is erroneously high. The purpose of the cost estimate in the RI/FS is to estimate costs within +50% to -30% of actual costs. Therefore it truly is just a cost estimate and may be significantly different from actual costs. The important part of the cost estimate is that all alternatives are evaluated similarly and therefore the cost estimate gives an indication of how each alternative compares to the others.

> **Comment #10-8:** The cost for hydraulic dredging appears to be grossly exaggerated when compared to actual hydraulic dredging projects being completed today in the same geographic region. EPA estimated divers would be necessary at a cost of $300,000 when in reality this would rarely, if ever, be used.

Response: EPA thinks its cost estimate for Alternative 2A is reasonable based on our experience with the Manistique hydraulic dredging project, which is currently on-going in the state of Michigan. Divers have been used by EPA for equipment maintenance, equipment repair, equipment retrieval, sampling if necessary, surveying/assessing if necessary and possible spot dredging around bridge piers if necessary. It is possible that divers would not be used, but it is also possible that they would be used more than we assumed at an even greater cost.

> **Comment #10-9:** Several of the line items in the cost for Alternative 4 do not appear to match the technical approach in the text of the RI/FS such as (1) there is no line item for excavation equipment and (2) there is a line item for sectional spud barge and gravity settling tanks.

Response: The commenter points out a valid oversight in the line item equipment charge. Alternative 4A should have two excavators listed instead of a 20-ton crane. The cost however will virtually remain the same. EPA disagrees with the commenter's concern over the barge and settling tanks. The equipment is required to complete the project. The barge is required to install the coffer dam and the settling tanks or equivalent will be needed for primary water treatment.

> **Comment #10-10:** It appears that the cost estimates developed in the FS are not truly

representative of the actual approaches that would be used on this site, but instead were extrapolated from other jobs or are out of date and not reflective of the current thinking on the project. As such, the relative ranking of alternative that has been conducted, in large part based upon the cost estimates, may not be valid.

Response: EPA disagrees that our cost. estimates are out of date and not reflective of current thinking on the project. As indicated above, the Manistique, MI project is not out of date, it is currently on-going. EPA used costs from the Manistique, MI project as a guideline, not verbatim. EPA's cost analysis reflects the site-specific approach envisioned for the Velsicol site. A significant amount of thought, time and energy went into the cost estimates. However, modifications to the approach typically occur after construction begins. Actual site methods often are not finalized until after construction begins.

Comment #10-11: Based on the technical and financial questions raised above, the selection of a recommended alternative should be re-evaluated based on correct cost analyses and a critical review of the technical implerhentability and health risks associated with each alternative.

Response: EPA has modified the final cleanup plan in the ROD to include the possibility of dredging in areas of the St. Louis Impoundment that may not be able to be excavated. EPA does not agree that there are significant technical or financial questions with the analysis that was completed in the final RI/FS report.

11. Mr. Edgar Ilgenfritz wrote the following comment:

Comment #11-1: As a downstream resident I am alarmed at the idea of scooping out the sediments and that the otherwise healthy river below the dam may not be so after this effort is complete. The 1986 flood scoured the river and EPA's actions may destroy this result. I wonder if any samples of fish from below the dam have been taken.

Response: Mr. Frederick Brown made similar comments, see EPA's response Comment #7-3 and #74 above. Fish samples have been collected below the dam and they are highly contaminated. Removing the source of contamination from St. Louis will benefit the downriver fish and therefore the downriver residents.

12. The Velsicol Chemical Company submitted an 11-page technical report prepared by Blasland, Bouck & Lee entitled *Review Summary for Final Streamlined Remedial Investiagion/Feasibility Study Report, October 1998*. Except for comments on the cost estimates, it is not easily discernable which parts of the text are actual comment and which parts are narrative. EPA has summarized what appeared to be significant comments below:

Comment #12-1: Section 2.1 - Site Description. The hydrology and hydraulics section of the RI/FS report lack data such as basic flow statistics, velocity distributions, shear stresses during extreme flows, etc. which appears to affect the development and evaluation of the alternatives. For example, given that the alternatives include the construction of temporary dams, movement of sediment laden barges, or sediment capping more detailed analysis is required to determine if flow can be diverted or if the existing dam can be operated to optimized barge mobility or if armoring is necessary for capping. No mention is made of the 1986 flood and any effect it may have had on the system.

Response: EPA does not agree that the hydrology and hydraulics section of the RI/FS Report need to contain the kind of detailed information listed above to adequately develop and evaluate cleanup alternatives. The DDT contamination is located in the St. Louis Impoundment which is immediately up-river of the St. Louis dam and down-river of the Alma dam. Water flows and volumes in this part of the river are regulated by the dams. EPA evaluated all practical cleanup alternatives. Capping sediments in place was found to be less favorable than sediment removal for several reasons, (1) the water level in the impoundment in large areas is very shallow and a cap would produce "islands" in the Impoundment, (2) capping would require long-term operations and maintenance, sediment removal would not, and (3) EPA could not be certain that capping in place would reduce the level of contamination in fish tissue, whereas removal of sediment is a permanent solution. The 1986 flood was not mentioned specifically, but scouring of a cap was considered.

Comment #12-2: Section 2.2.1 - Source Nature and Extent - Sediment.

#12-2a: Table 2.2-2 does not appear to contain the 1996 sediment data as indicated since it is identical to Table 2.2-8 which is only 1997 sediment data.

Response: The commenter is correct, EPA did mistakenly leave the 1996 sediment data out of Table 2.2-2. The corrected table is as follows:

Table 2.2-2: Total DDT Concentration per Depth Interval (1996/1997 Data)

Depth Interval (in.)	Max. Conc. (ppm)	Avg. Conc. (ppm)	Min. Conc. (ppm)
0-6	229	25.4	1.3
6-30	32,600	1300	0.2
30-54	32,600	1320	0.42
54-112	822	102	0.42

#12-2b: The use of simple arithmetic averages, while a mathematically correct method to compute means, do not present a realistic description of the central tendency and distribution of the DDT concentration data due to the high skewed distribution that includes occasional extreme high values.

Response: EPA did not calculate "simple arithmetic averages," the ArcView/ Spatial Analyst software that was used computed the mean for each interval. The use of the word "average concentration" in the RI/FS Report data tables 2.2-2, 2.2-4, 2.2-5, 2.2-6 and 2.2-8 was incorrectly used.

#12-2c: In the 1997 data set, maximum, average and minimum DDT concentrations presented are all influenced by the unconventional method of handling non-detects. The non-detects were reported as having been detected at the detection limit of 15 ppm. In addition, the RI/FS report states that 7 samples were greater than 1,000 ppm when the reference table indicates only 5 samples from 3 cores were above 1,000 ppm.

Response: EPA did assign all sediment sample non-detects the value of the detection limit, and although this may be a conservative approach EPA does not consider it to be "unconventional." The reference table in Appendix A of the RI/FS Report is correct with 5 samples that were greater than 1,000 ppm. The 5 samples were used for the data analysis. The data from the lab showed 7 samples with levels greater than 1,000 ppm. Two of the 7 samples were matrix spikes and therefore were not included in the data analysis.

#12-2d: Part of the possible increase in average DDT concentrations observed in 1997 is due to the inclusion of total DDT isomers in the 1997 chemical analysis that were not previously included in the analysis of total DDT concentrations. Based on the data table presented, inclusion of the para-para isomers may increase total DDT concentrations by as much as 4 times.

Response: EPA's analysis for para-para isomers of total DDT gives a more complete total DDT concentration in sediments and indicates the concentrations were underestimated in the past. This also occurred with the fish tissue data. The 1997 fish tissue data was also analyzed for ortho-para DDD and DDT, which had not previously been analyzed for. This increased fish tissue concentrations since significant levels of ortho-para DDD were found in fish tissue. This additional chemical analysis shows that the concentrations in fish tissues were also underestimated in the past. Analysis of para-para-DDTr only (pp-DDT + pp-DDE + pp-DDD) carp fillet data show that the increase in fish DDTr content over the last decade is not an artifact of later inclusion of ortho-para-DDTr analytes. Lipid-normalized pp-DDTr concentrations have increased 50 to 70 % between the 1980s and the late 1990s below and above the St. Louis dam, respectively (Table A and Figure A).

The observed increase in pp-DDTr concentration in carp fillets also is not an artifact of changing lipid content over the years as shown in Figure B. Impoundment carp had much greater lipid-normalized pp-DDTr concentration in 1995 than in 1989 while lipid content remained constant over the same interval. The downstream carp also do not exhibit a linear relationship between lipid-normalized pp-DDTr concentration and lipid content. These data confirm there has been a substantial increase in the bioavailability of pp-DDTr in the Pine River system over the last decade. The expected natural attenuation of the impoundment sediment DDTr has not occurred.

Figure A. lipid-normalized Total pp-DDTr concentration and Carp Fillets Collected from the Pine River Above and Below the St. Louis Dam MI.

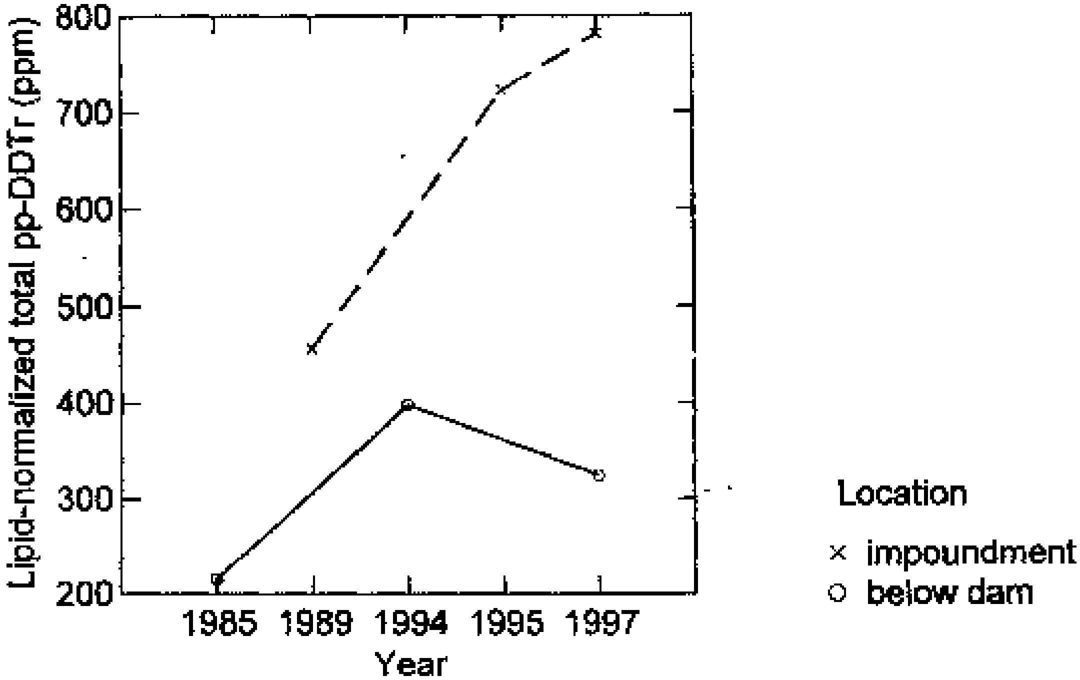
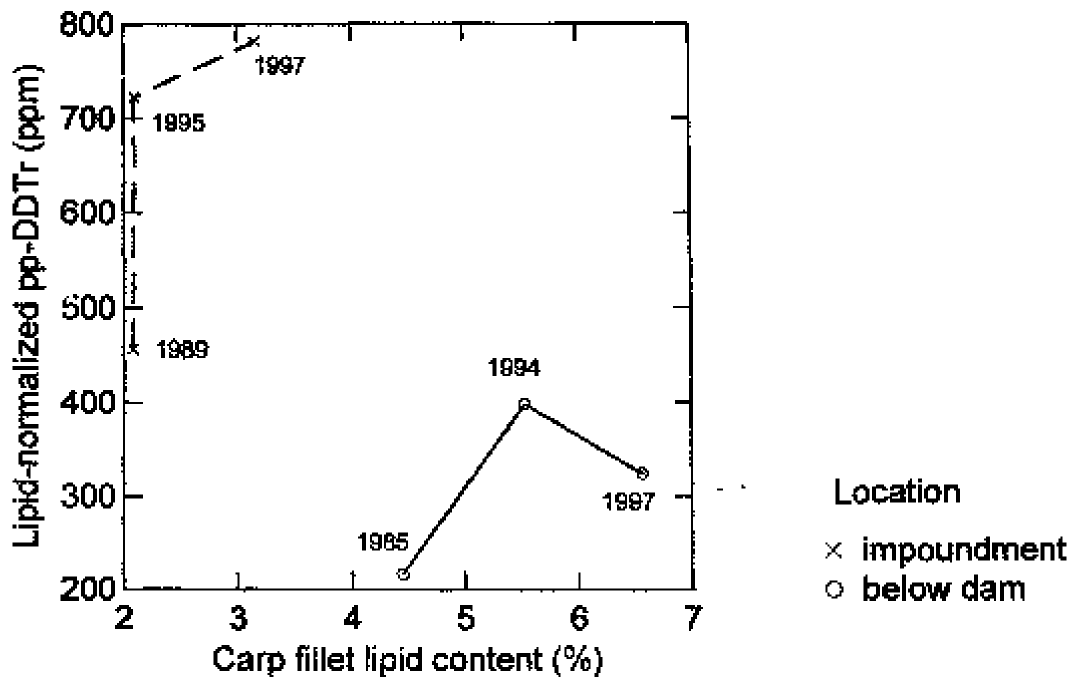


Table A. Skin-off Fillet Carp Samples, Pine River, MI, 1985-1997, Above and Below the St. Louis Dam, Michigan.

Year	Location	Number of fish	Weigh t	Lipid Cont	pp-DDTR Cone	
			mean	mean	whole tissue	lipid-normalizes
			kg	%	ppm	ppm
1985	below dam	8	1.209	4.45	9.6	215.73
1989	impoundment	10	1.149	2.08	9.5	456.73
1994	below dam	10	2.001	5.53	22	397.83
1995	impoundment	10	1.789	2.09	15.1	722.49
1997	below dam	12	2.819	6.56	213	324.70
1997	impoundment	8	3.099	3.15	24.6	780.95

Figure B. Lipid-normalized Total pp-DDTr Concentrations versus Lipid Content in Carp Fillets



Collected from the Pine River Above and Below the St. Louis Dam, MI.

> **#12-2e:** Table 2.2-3 in the RI/FS report indicates that more than 90% of the DDT mass is contained in under 10% of the sediment volume, yet there is no analysis for any action level other than 5 ppm and 1 ppm.

Response: Based on data analysis, EPA concluded that the area, volume, and mass for total DDT levels greater than 5 and for total DDT levels greater than 10 ppm both contained the same boundary areas. A clean-up action level of I ppm did not pose a significant decrease in the risk when compared to an action level of 5 ppm, but was almost double in volume. Therefore an action level of 5 ppm was decided upon because of its greatest reduction in risk that would allow for DDT in the river to be at a safe level for ecological and human health.

> **#12-2f:** On page 15, the report states that volumes were calculated using the results of the Inverse Distance Weighting (IDW) technique for sediment depths; however, later on page 80 a uniform depth of 5 feet is used, yet the same volumes are obtained.

Response: Page 15 of the R1/FS Report is correct in stating that the volumes were calculated from sediment depths using the results of the IDW interpolation method. The use of a uniform depth of 5 ft on page 80 was to give the reader a relative number that could be used by the reader to quickly calculate an estimated volume.

> **#12-2g:** On page 16 of the RI/FS Report it states that "interpolations are able to simulate a more realistic distribution of concentration." This gives a misleading sense of the accuracy of the interpolations because (1) there is no alternative to which the interpolation is being compared; (2) it doesn't take into account the effect of a few extreme values in a sparse sampling network in overestimating the extent of high concentration zones; (3) the use of only maximum concentration for each core will overestimate concentrations of environmental relevance, especially when the maximum for some cores were deeper than 30 inches and (4) because of the way non-detects were handled the interpolation technique will overestimate concentrations at the lower end of the concentration ranges presented.

Response:. Regarding the comment on page 16 of the RI/FS Report: in order to determine the best spatial representation of the data, determine surface-area weighted concentrations for risk assessment purposes, and calculate volume and mass of contaminants in the impoundment, three possible methods existed: depth-weighted arithmetic average, thiessen polygons, and inverse distance weighted (IDW).

Depth-weighted averaging was removed from consideration because of the ability to do spatial interpolations, and more accurately represent the extent of contamination. Depth-weighting can be useful in small, concentrated areas of interest, but may artificially inflate concentrations when few samples are available over a large area, and large values skew the results.

The thiessen polygon method involves constructing polygons by connecting the midpoints of lines between each sample point. Sample concentrations are then multiplied by the area associated with each polygon, and divided by the total area of interest. In this manner, there is no gradation of concentration between sample points, only blocks of concentration.

In comparison, inverse distance weighting allows creation of concentration contours, and a more visual picture of the concentration range. IDW was the preferred method due to its ability to simulate a more realistic distribution of concentration. Samples with high concentrations only influenced cells in a close proximity, whereas with thiessen polygons, actual concentrations must be used for a large surrounding block. In IDW, a grid is created of equal size cells, each cell is then assigned a value according to a weighted formula of nearest neighbor sample points (i.e., the closer a sample point, the more its concentration influences the value of the grid cell). To calculate a surface-area weighted concentration, the concentration of each grid cell was summed, and divided by the total area.

IDW interpolations, however, are considered more realistic due to the localized nature of contamination. When large gaps exist between sample points, and a single value is assigned to that area, average concentrations will be increased. Therefore the IDW method was preferred.

Maximum Concentrations were taken per sediment core depth interval(0-6 in, 6-30 in, 30- 54 in, and 54 - 112 in) not per sediment core. The data were queried per interval. The maximums for each separate interval were taken. Each interval layer was then interpolated separately. All intervals were interpolated by its maximum value.

> **#12-2h:** On page 24 of the RI/FS Report, if the sediments are remaining in place one would not expect significant change in the concentrations as a whole and especially at depth where maximum concentrations are found. The declining trend in DDT concentrations at the surface is not discussed in the RI/FS.

Response: Rivers are dynamic and unpredictable systems. It is feasible that the highly contaminated sediments that are currently at depth may someday become exposed to the surface. The declining trend in DDT concentrations at the surface is not highlighted in the RI/FS Report because it obviously has not positively impacted fish tissue concentrations. The fish tissue data shows that the decrease in sediment surface concentrations is not resulting in any decrease of risk to human health or the environment.

> **Comment #12-3:** Section 2.2.1 - Source Nature and Extent - Fish Data. EPA's report identified "trends" and "significant increases" in concentrations in fish tissue without any statistical evaluation. Most of the increase of total DDT levels reported in 1997 fish samples are actually due to a change in analytical method, not necessarily changes in fish tissue concentration. No statistical adjustment is made for the potential influence of increasing weight and lipid concentrations. Other factors such as gender, season of collection and location of collection could influence DDT concentrations in fish. The

shortage of benthic organisms in the St. Louis Impoundment would account for the disturbing trend that carp collected in the impoundment have less than 50% the fat of fish collected below the dam.

Response: The commenter does not indicate what type of "statistical evaluation" it believes is appropriate. EPA does not agree that the increased levels of total DDT in 1997 fish tissue is due to a change in analytical method. EPA did look at lipid normalized fish tissue data, see EPA's response to Comment #12-5. EPA agrees that a lack of benthic organisms in the Impoundment may be one explanation for the decreased % fat in fish collected from the Impoundment.

Comment #12-4: Section 2.3 Streamlined Risk Assessment.

#12-4a: The use of maximum detected sediment concentrations as exposure point concentrations is extremely conservative to the point of being unrealistic, and is inconsistent with EPA 1992 guidance.

Response: In addition to using the maximum concentrations for the RME scenario, the average was used in the central tendency scenario (see Table 2.3-4, page 40 in the RI/FS Report). The maximum was used because in some cases the highest detected levels were near the river's edge or near homes, therefore the maximum might very well be what people are exposed to. Because of the site-specific circumstances, it is not unbelievable that such exposure will actually occur.

#12-4b: The risk assessment does not factor in the effects of the hot spot removal.

Response: EPA had completed the baseline risk assessment and based *on the results of the baseline risk assessment* determined that a time-critical removal action would be appropriate for sediments in excess of 3,000 ppm. total DDT. Therefore the decision to conduct the time-critical removal was an outgrowth of the baseline risk assessment, not the other way around. In addition, as of February, 1999 no sediments have yet been removed from the Pine River, therefore it would not be appropriate to assume this work is completed when it is not.

#12-4c: The approach used for dermal contact is inconsistent with that used at other sites. EPA guidance (1994) suggest that limited dermal contact be considered. At other sites, in the absence of beaches, dermal contact has been eliminated as an exposure pathway.

Response: Site-specific information is always an important consideration, and in this case it is very relevant to determining whether dermal contact should be evaluated. Many homes border the river with no barriers at all; several homes have their backyard abutting the water (no fence, just grass and then water). Therefore, river overflow and access is obvious. A toy could be thrown from a backyard and land in the river. Therefore, EPA felt the exposure was quite real and important to assess.

#12-4d: The equation on page 34 is for estimating incidental ingestion of sediment, yet the equation uses fish data as the concentration term.

Response: The commenter is correct, there is a typo with the equation on page 34 of the RI/FS Report. It is the incidental ingestion equation, but the commenter was incorrect in stating that CS is concentration in fish, CS is the concentration in soil. This equation should be taken out since incidental ingestion was not done. The fish ingestion equation should be put in instead, and the CS term in the equation should be CF and the conversion factor removed. The corrected section is:

<u>Fish Ingestion Exposure Equation</u>

Equation for estimating exposure intake to contaminants due to incidental ingestion of chemicals (USEPA RAGS, 1989).

$$\textbf{Exposure} = \frac{\textbf{CF X IR X FI X EF X ED}}{\textbf{BW X AT}}$$

where:

CF	concentration in fish
IR	ingestion rate
FI	fraction ingested
EF	exposure frequency
ED	exposure duration
BW	body weight
AT	averaging time

#12-4e: The report says it likely underestimates risk, however the conservative exposure variables and maximum concentrations used will tend to overestimate risk.

Response: EPA relied on the reasonable maximum exposure (RME) scenario for estimating risk, which most likely does not overestimate the risk at the site.

Comment #12-5: Section 2.4- Ecological Risk Assessment.

#12-5a: The use of whole-body carp concentrations to evaluate potential intake for herons is unrealistic. According to EPA (1993), 95% of fish consumed by great blue herons in a Wisconsin population were less than 25 cm in length.

Response: Uncertainty associated with the size of the carp is discussed in the ecological risk assessment (ERA). This may result in an overestimation of risk to heron, however, it is the only available data for performing an ERA at the site. The possible overestimation of risk due to use of contaminant data from over-sized fish is probably more than compensated for by the use of the kestrel toxicity reference value (TRV) instead of the TRV for brown pelican, which is an order of magnitude more sensitive to the effects of DDT than kestrels. The difference in DDT levels in large and small carp is unlikely to approach an order of magnitude.

> **#12-5b:** BSAF is used to make the connection between sediment concentration and risk, but there are several problems with using it: (i) no explanation for the different BSAF between Impoundment carp and downriver carp; (2) it is unclear what sediment depths are being used in the BSAF calculation; and (3) what values for fish DDT concentrations and sediment DDT concentrations were used to derive the BSAF coefficient of 0.207 presented on page 68; and (4) vastly different BSAFs would be computed using fish data and sediment data from the Impoundment for different time periods.

Response: **1)** Impoundment and downriver BSAF differences. Downriver carp were not assessed in the ERA because whole-body analyses were not available. However, the biota-sediment accumulation factors (BSAF) for the impoundment and downriver carp would not be expected to be the same because of differences in exposure routes between the two locations. Fish in the impoundment are exposed both to direct absorption of dissolved DDTr in the water column and to food chain uptake - probably through partitioning of DDTr from sediments to detritus (the remains of plants). The downriver reaches have few depositional areas. This means that downriver sediments are not a significant source of exposure to downriver fish. Instead, the downriver fish probably receive the majority of their exposure from the water column. The exposure route for downriver fish is the following: impoundment sediment DDTr - partitioning to impoundment surface water - transport of dissolved DDTr downstream - direct uptake from surface water by downriver fish. The significant relationship for downriver fish contaminant levels is therefore with downriver surface water DDTr concentrations, not with downriver sediment concentrations. Support for this hypothesis is the close agreement between the back-calculated downriver surface water DDTr concentration (0.2 ppb), based on downriver lipid-normalized carp fillet data and assumed water column only exposure, and the measured surface water DDTr concentration (0.3 ppb) below the St. Louis dam (see 4 below for calculations).

2) BSAF and sediment depth. The BSAF was calculated on the basis of the surface area weighted total DDTr (op- and pp-DDTr) concentrations in surficial sediments (0 to 6 inches depth).

3) Derivation of BSAF (fish and sediment values). The BSAF value of 0.207 used in the ERA for whole carp is based on a surface area weighted TOC-normalized total DDTr concentration of 5032.9 ppm (dw) in surficial sediments throughout the impoundment, and a lipid-normalized total DDTr concentration of 1040.1 ppm (ww) in whole carp.

4) Differences in BSAF over time is an important point. The lipid-normalized carp fillet data show that DDTr has become increasingly more bioavailable over time (Table 1 and Figure 1). If this trend continues, the BSAFs based on 1997 data will likely underestimate future accumulation in river biota. This provides strong evidence that the former approach to allow the contaminated sediments in the St. Louis Impoundment to naturally attenuate, presumably by deposition of clean sediments over the contaminated ones, was inadequate for this site.

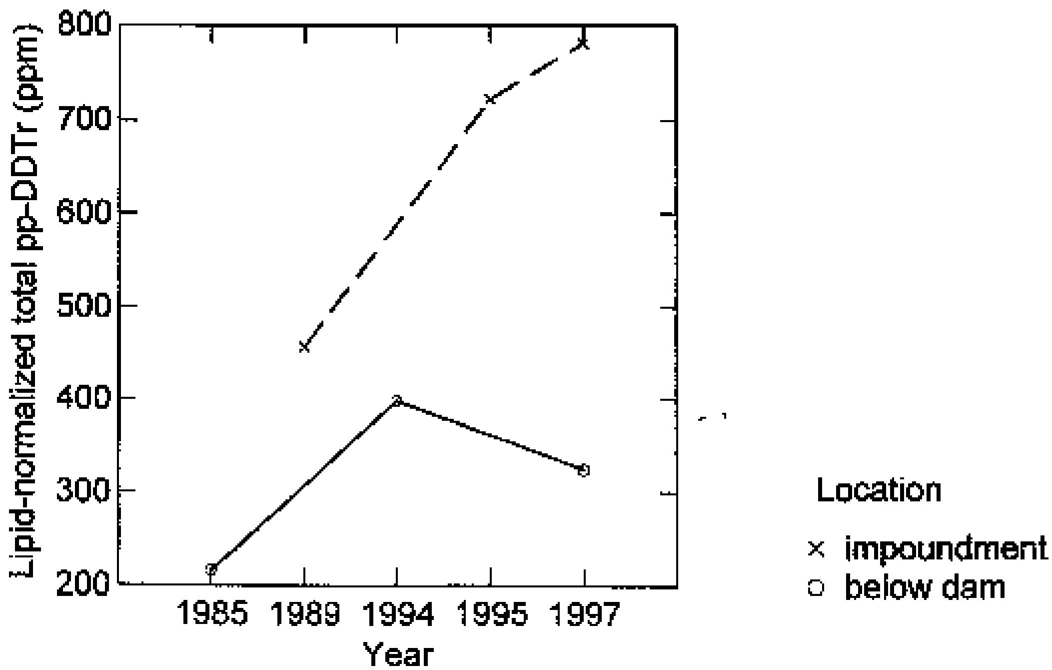
There are two forms of DDTr: para, para- (pp-DDTr) and ortho, para- (op-DDTr). The former (pp-DDTr) are more toxic and persistent that the latter (op-DDTr), and comprise the majority of the DDTr in the river biota. As part of an evaluation of contaminant trends in the Pine River, ppDDT, pp-DDD and pp-DDE were summed to determine pp-DDTr concentrations in carp fillets collected downstream of the St. Louis dam (op-DDTr was not included because it was not analyzed in samples collected prior to 1997 - the sum of the op- and pp-DDTr is 25 - 38 % higher than pp-DDTr in 1997 downstream and impoundment carp fillet samples, respectively).

The trends in bioavailability are best seen in the downstream data because the exposures are predominantly through surface water absorption (see 1 above). The concentration of pp-DDTr is 21.3 ppm in downstream carp fillets in 1997. Since DDTr is highly lipophilic ("fat loving"), virtually all of it is stored in fat tissue. For this reason, DDTr data are converted to a lipid-normalized basis, that is, the, concentration in fillets is divided by the fillet fat content (6.56 % in 1997 downstream carp fillets) to determine the concentration in fat tissue only. The 1997 downstream carp lipid-normalized DDTr concentration is 324.7 ppm (21.3 ÷ 0.0656). Under the assumption that the predominant route of exposure to downstream fish is direct absorption from the surface water (partitioning from the water column), the relation between surface water and lipid-normalized concentrations can be estimated from the octanol-water partitioning coefficient (K_{ow}), which is the ratio of the concentration of a chemical dissolved in octanol divided by the concentration in water. The log K_{ow} for DDT is 6.19 (ATSDR 1994). Log K_{ow} is presented as a base 10 logarithm, which means it is an exponent of 10 (i.e., 10^{619} = 1,548,817). In this case, DDT occurs in octanol (a surrogate for fat) in concentrations over 1.5 million times higher than in water. Divide the lipid-normalized DDTr concentration by K_{ow} to estimate the surface water DDTr concentration (Duursma and Carroll 1996), which, for 1997, equals 0.00021 ppm, equivalent to 0.21 ppb. This approach depends in part on how reliably octanol serves as a surrogate for lipids. A review of several studies showed that for persistent organic compounds, "octanol provides a reasonable representation of biota lipid for compounds with log K_{ow} values between 2 and 6.5, (Connell 1998). The calculated downstream surface water DDTr concentration (0.21 ppb in 1997, 0.27 ppb in 1994) is close to the measured concentration below the dam (0.3 ppb sampled 8/4/98). In contrast, the calculated downstream surface water concentration was 0.14 ppb in 1985. Between the mid-eighties and the mid-nineties, downstream surface water pp-DDTr concentrations increased by 50 to 86 %. Since there are no identified local downriver sources, this indicates that the rate of release of DDTr from the impoundment sediments to the surface water has increased over the last decade.

The calculated impoundment surface water pp-DDTr concentrations range from 0.3 ppb in 1989 to 0.5 ppb in 1997. Both are greater than the measured surface water concentration at the Mill Street Bridge, 0.21 ppb, sampled 8/4/98. The difference is probably due to the additional food chain exposure to fish in the impoundment. However, the data show that the combined surface water and food chain exposures to carp in the impoundment have increased by 67 % between 1989 and 1997, consistent with the trend in downriver data.

Figure 1. Lipid-normalized Total pp-DDTr Concentration in Carp Fillets Collected from the Pine River Above and Below the St. Louis Dam, MI.

Table 1. Skin-off Fillet Carp Samples, Pine River, MI, 1985-1997, Above and Below the St. Louis Dam.



Year	Location	Carp	Body weight	Lipid Content	pp-DDTr Concentration	
		number	mean kg	mean %	whole fillet ppm	lipid-normalizes ppm
1985	below dam	8	1.209	4.45	9.6	215.73
1989	impoundment	10	1.149	2.08	9.5	456.73
1994	below dam	10	2.001	5.53	22	397.83
1995	impoundment	10	1.789	2.09	15.1	722.49
1997	below dam	12	2.819	6.56	21.3	324.70
1997	impoundment	8	3.099	3.15	24.6	780.95

Literature Cited:

ATSDR. 1994. Toxicological Profile for 4,4'-DDT, 4,4-DDE, 4,4'-DDD (Update). U.S. Dept. Health & Human Services, Agency for Toxic Substances and Disease Registry. TP-93/05. 166 p.

Connell, D. 1998. Bioaccumulation of chemicals by aquatic organisms. *In* G. Schüürmann and B. Marked (eds.). 1998. Ecotoxicology: Ecological Fundamentals, Chemical Exposure, and Biological Effects. Wiley, New York. pp. 439-450.

Duursma, E. and J. Carroll. 1996. Environmental Compartments: Equilibria and Assessment of Processes between Air, Water, Sediments and Biota. Springer, New York. 277 p.

Edwards, R., H. Egan, M. Learner and P. Maris. 1964. The control of chironomid larvae in ponds, using TDE (DDD). J Appl Ecol 1: 97-117.

Matsumura, F. 1985. Toxicology of Insecticides, 2nd ed. Plenum Press, New York. 598 p.

NIOSH. 1994. NIOSH Pocket Guide to Chemical Hazards. National Institute for Occupational Safety and Health. U.S. Gov. Printing Office, Washington, D.C.

Polder, M. and E. Hulzebos and D. Jager. 1995. Validation of models on uptake of organic chemicals by plant roots. Environ Toxicol Chem 14: 1615-1623.

Webber, E., D. Bayne and W. Seesock. 1989. DDT contamination of benthic macroinvertebrates and sediments from tributaries of Wheeler Reservoir, Alabama. Arch Eviron Contam. Toxicol 18: 728-733.

Comment #12-6: Clean-up Goals.

#12-6a: There is an error in the volume break point analysis. The removal of material from 5 to 1 ppm interval results in removal of 254,300 cy and 4,400 lb. (0.0173 lb/cy or 17 ppm). In other words the additional material removed between the 5 ppm and 1 ppm DDT concentrations has an average concentration of 17 ppm according to the data as presented in the table.

Response: EPA does not understand the commenters concern with the volume break point analysis (Table 2. 5-1).

#12-6b: The basis for the post-remedial fish DDT concentration calculation is without any supporting documentation. The assumed residual sediment concentrations used in computing fish concentrations and the risks are unexplained. Is the assumption being made that a concentration of 0 ppm can be achieved by removal?

Response: Post clean-up goals were calculated using estimated post-clean-up sediment concentrations:

- 5 ppm clean-up goal with an estimated post clean-up goal of 1.5 ppm concentration in sediment
- 1 ppm clean-up goal with an estimated post clean-up goal of 0.75 ppm concentration in sediment

Using the estimated post clean-up goal sediment concentrations, we were able to back calculate for a post-remedial fish concentration as shown in the Table 1 for clean-up goal of 1 ppm and Table 3 for clean-up goal of 5 ppm. Once post-remedial fish concentrations were established, we were then able to calculate the post remedial risk for the two clean-up goals of 1 ppm and 5 ppm as shown in Tables 2 and 4 respectively.

Table 1
Post Clean-Up Goal / Risk Assessment
Pine River Superfund Site

Clean-Up Goal = 1 ppm.

Concentration In Fish Post- Cleanup -> CF=(CSxBSAFxlipid) /(toc)

Species	CS	toc	BSAF	lipid	CF
smallmouth bass	0.74	1.23	0.159	1.66	0.1601
smallmouth bass-75 ucl	0.89	1.25	0.166	3.86	0.4583
smallmouth bass-95 ucl	1.12	1.29	0.179	3.96	0.6322
smallmouth bass- whole	0.74	1.23	0.171	3.80	0.3954
carp	0.74	1.23	0.296	3.15	0.5671
carp- 75 ucl	0.89	1.25	0.357	3.19	0.9967
carp- 95 ucl	1.12	1.29	0.454	5.18	2.0339
carp- whole	0.74	1.23	0.241	6.17	0.9033
carp- whole-95 ucl	1.12	1.29	0.385	6.85	2.2824

Table 2

POST CLEAN-UP RISK		CLEAN-UP GOAL OF 1ppm		
smallmouth bass center		**sport**	**middle**	**subsis**
	CF	0.1601	0.4583	0.6322
	BW	70	70	70
	AT	25550	25550	25550
	IR	0.02	0.075	0.13
	FI	0.25	0.5	1
	AB	1	1	1
	EF	365	365	365
	ED	9	9	30
	slope	0.34	0.34	0.34
	RISK	5.00E-07	1.07E-05	1.17E-04

carp	**Cancer**	*sport*	*middle*	*subsis*
	CF	0.5671	0.9967	2.0339
	BW	70	70	70
	AT	25550	25550	25550
	IR	0.02	0.075	0.13
	FI	0.25	0.5	1
	AB	1	1	1
	EF	365	365	365
	ED	9	9	30
	slope	0.34	0.34	0.34
	RISK	1.77E-06	2.33E-05	5.50E-04

Table 3

Post Clean-up Goal/ Risk Assessment
Pine River Superfund Site

Clean-Up Goal = 5 ppm

Concentration In Fish Post Clean-up CF=(CS x BSAF x lipid) /(toc)

Species	CS	toc	BSAF	lipid	**CF**
smallmouth bass	1.46	1.23	0.159	1.66	0.3135
smallmouth bass- 75 ucl	1.56	1.25	0.166	3.86	0.8001
smallmouth bass- 95 ucl	1.72	1.29	0.179	3.96	0.9400
smallmouth bass- whole	1.46	1.23	0.171	3.80	0.7743
carp	1.46	1.23	0.296	3.15	1.1105
carp- 75 ucl	1.56	1.25	0.357	3.91	1.7401
carp- 95 ucl	1.72	1.29	0.454	5.18	3.1209
carp- whole	1.46	1.23	0.241	6.17	1.7690
carp- whole- 95 ucl	1.72	1.29	0.754	7.94	7.9399

Table 4

POST CLEAN-UP RISK **CLEAN-UP GOAL OF 5 ppm**

smallmouth bass	**Cancer**	sport	middle	subsis
	CF	0.31	0.80	0.94
	BW	70	70	70
	AT	25550	25550	25550
	IR	0.02	0.075	0.13
	FI	0.25	0.5	1
	AB	1	1	1
	EF	365	365	365
	ED	9	9	30
	slope	0.34	0.34	0.34
	RISK	9.79E-07	1.87E-05	2.54E-04

carp	**Cancer**	sport	middle	subsis
	CF	1.11	1.74	3.12
	BW	70	70	70
	AT	25550	25550	25550
	IR	0.02	0.075	0.13
	FI	0.25	0.5	1
	AB	1	1	1
	EF	365	365	365
	ED	9	9	30
	slope	0.34	0.34	0.34
	RISK	3.47E-06	4.07E-05	8.45E-04

#12-6c: Also missing are post-remedial risks for 10 ppm and 100 ppm cleanup levels. This would make it possible to compare a risk-based break point.

Response: Post remedial risk associated with a cleanup level of 100 ppm was not assessed because it exceeds the calculated range of ecologically protective sediment concentrations by 1 to 2 orders of magnitude. A 10 ppm cleanup level is just at the high range of the calculated ecologically protective sediment concentrations. Serious consideration of this cleanup level would require a close second look at the uncertainties in the ecological risk assessment (ERA) that result in possible underestimations of risk - in particular, the lack of consideration of the joint effects of simultaneous exposure to DDE, DDT and DDD (the protective levels calculated in the ERA are based on the effects of DDE alone) and the selection of kestrel toxicity data instead of the much more sensitive brown pelican data. These uncertainties are of lesser significance for cleanup levels below the upper margin of the calculated protective sediment levels.

> **#12-6d:** Also unexplained is why postulated rates of decrease differ for smallmouth bass (93.6%) and carp (96%) using the same removal scenario.

Response: EPA considers the difference between 94% rate of decrease and 96% rate of decrease to be so similar as to be the same.

> **Comment #12-7:** Identification and Screening of Remedial Technologies.

> **#12-7a:** The FS only assesses two alternatives other than the No Action alternative and doesn't include in-situ immobilization or natural recovery. The report demonstrates no significant difference in understanding of the system hydraulically, geotechnically and physiochemically from 1982 when the No Action alternative was selected for Pine River sediments.

Response: EPA considered all viable cleanup options, one approach to in-situ immobilization is capping and EPA did evaluate this alternative. Another approach to in-situ immobilization is in-situ solidification which has been demonstrated on a very limited scale (Mannitowoc, WI) without success. See *The ARCS Remediation Guidance Document,* October 1994, EPA 905-R94-003. Natural recovery is the alternative that was selected in 1982 for Pine River sediments. The 1998 RI/FS report shows conclusively that natural recovery has not been effective at reducing contaminant levels in fish. Another possible reason natural recovery was selected in 1982 was because dredging of contaminated sediment was not commonly done and the technology was not developed as it is today.

> **#12-7b:** The hot spot removal dredging alternatives (2B and 3B) were screened out for not being protective of human health and the environment, why?

Response: The hot spot dredging alternatives were screened out because the 5 ppm total DDT cleanup level could not be achieved by limiting dredging to hot spots and therefore EPA does not consider these alternatives to be protective of human health or the environment. The 5 ppm total DDT cleanup level is associated with fish tissue contaminant levels that would be safe for humans and fish-eating birds to eat.

#12-7c: On page 95 of the RI/FS Report, Table 3-7, Number 7, there is no support for the statement that in-situ containment "...may not reduce the bioavailability of contaminants in fish." It is unclear what basis was used to design the cap and how the need to replenish every 5 years was determined. The ongoing deposition of cleaner material and a recent report of DDT biodegradability (Renner, 1998) enhances the argument for an in-situ containment alternative or no action remedy.

Response: The commenter is incorrect when they say there is no support for EPA's analysis that capping may not reduce the bioavailability of contaminants in fish. The Chicago office of the Army Corps of Engineers (ACOE) verifies that there are many unknowns with how effective a cap will be in reducing bioavailability of contaminants to fish. Physical disturbances, diffusion and advection all can compromise the ability of a cap to perform adequately. In addition, capping is not a proven technology in shallow water, nationally caps have only been installed at deep water sites, and none of these sites have post-monitoring data to show that they have been effective at reducing contaminant levels in fish., Dredging on the other hand has been shown through post-monitoring data at the Waukegan Harbor site in Illinois to have reduced contaminant levels in fish such that a fish advisory was removed. At the Black River site in Ohio dredging resulted in reduced numbers of tumors in fish. Deposition of cleaner material and DDT biodegradability are not effective at reducing contaminant levels in fish as evidenced by the fish data which clearly show that although contaminant levels in the top 6 inches of sediments is declining, contamination in fish tissues is not.

Comment #12-8: Detailed Analysis of Alternatives.

#12-8a: The FS does not take into consideration the effect of the time-critical removal action which will alter the goals and assumptions of the FS. To optimize the removal scenario, various post-RA DDT concentrations could be evaluated vs the expected reduction in mass and anticipated residual concentrations. Nowhere in the RI/FS is the expected residual concentration of DDT presented. If the uptake mechanism for fish is not known, how can EPA predict that a cleanup level of 5 ppm will result in significant fish tissue concentration decrease?

Response: The removal action currently being undertaken is consistent with the remedial action selected and does not alter the goals and assumptions made in the FS. The removal action will remove sediments that contain greater than 3,000 ppm total DDT. What will remain after the removal action will still be significantly above the cleanup goal of 5 ppm total DDT, the level EPA estimates will result in edible fish for both humans and fish-eating birds. The expected residual concentration after the removal action will still exceed 1,000 ppm, total DDT in some areas of the middle basin. As of this time, no contaminated sediment has been removed from the St. Louis Impoundment. EPA anticipates actual removal of the contaminated sediment to begin in late spring, 1999. EPA used the information from the 1997 sediment data and fish data to find a relationship between contaminant levels in sediment and contaminant levels in fish tissue. EPA then back calculated what the level in sediments would have to be to result in acceptable levels in fish tissue, this assumes that the uptake mechanism for fish is the same before the dredging and after the dredging. This number was 5 ppm total DDT. The volume break point analysis shown in Table 2.5-1, page 80 of the RI/FS report shows that in order to reach a cleanup goal of 10 ppm total DDT, 260,330 cubic yards of sediment would need to be removed. To reach 5 ppm total DDT, EPA would only need to remove an additional 2,000 cubic yards. The 5 ppm total DDT level is more protective than 10 ppm for a negligible increase in cost.

#12-8b: The potential need for polish dredging or capping residual materials after dredging has not been included in cost estimates. Residual concentrations at the dredged surface could be higher than at the pre-dredged surface. Deposition of cleaner material to reduce these concentrations could take several years.

Response: Most of the sediment removal will be completed down to the bottom of the river, which is clay, so there will be no need for polish dredging or capping of residuals in place. The clay will be sampled and if it exceeds 5 ppm total DDT EPA will dredge some of the clay also. Therefore, residual concentrations at the dredged surface will not exceed the pre-dredged surface.

The sediment data shows that deposition of clean material over the contaminated material is not adequately occurring, therefore EPA does not intend to rely on clean material covering contaminated material, since this has proven not to be effective as evidenced by the fish tissue data.

#12-8c: Increases in contaminant concentration in biota following dredging is not uncommon.

Response: Its true that sometimes there is a short-term increase of contaminants in biota, this however, does not negate the long-term good that will result from removing the contamination.

#12-8d: What about re-suspension? There doesn't appear to be enough detailed information about site specific conditions such as particle size distribution and the basis for adding drying agent at a 10% dose to evaluate the alternatives effectively.

Response: Re-suspension is being addressed through engineering controls such as silt curtains and coffer dams and turbidity monitoring. Treatability studies on solidification agents and particle size distribution tests were being conducted concurrently with the RI/FS report. The results of the tests were not reported in the RI/FS, however they will be available for review by the public.

#12-8e: It is unclear how EPA has determined that the DDT-containing sediment is not a hazardous waste.

Response: As set out in the RI/FS, the contaminated sediments are not considered to be listed hazardous waste under the Resource Conservation and Recovery Act (RCRA), 42 U.S.C. § 6901 et seq., because the contamination occurred primarily from the direct discharge of DDT process wastewater to the Pine River. U.S. EPA and MDEQ concluded that the primary source of the DDT contamination in sediment was industrial waste water discharges of Michigan Chemical Company (now Velsicol Chemical Corp.) based on review of site history. Michigan Chemical Company manufactured DDT until the late 1950s, and discharged its manufacturing process waste through numerous outfalls into the St. Louis impoundment and Pine River. Historical analytical data on the discharges from the outfalls showed that this manufacturing waste water contained DDT. The DDT-contaminated sediment that is the subject of EPA's response action is in the area of Velsicol's outfalls. Under RCRA regulations at 40 CFR § 261.33(d) comment, process manufacturing waste that contains DDT is not a listed waste under § 261.33.

The contaminated sediments were also tested by the TCLP (Toxicity Characteristic Leaching Procedure) and determined not to be RCRA characteristic hazardous waste.

> **Comment #12-9:** Cost Tables. Upon review of detailed costs, we believe that, overall, estimates are low. While this generalization does not necessarily apply to every remedial option, it appears consistent with the removal alternatives.

Response: EPA disagrees. Acceptable variance in costs for a treatability study can vary between -30% to +50%. Velsicol neither provides any data to substantiate their belief that overall costs are estimated low nor do they define which cost elements would be included in a dollar/volume value. Thus no accurate comparisons or evaluations can be made based on Velsicol's inferences.

Cost estimates are based on prevailing costs that U.S. EPA pays under Superfund, and equipment costs are based on quotes obtained from vendors contacted for this project.

Comment #12-10: It is worth noting that a recent (9/4/98) issue of Superfund Week indicates that a contract for $6M has been issued for the removal of 2 1,500 cy with removal over 120 days. The unit costs for the removal are significantly higher and production rates lower than those presented in the RI/FS cost estimates.

Response: The six million dollars include project setup/mobilization costs, removal and disposal costs. Some of the planned set-up/mobilization activities and associated equipment will remain on site for the second phase and results in a higher dollar value per yd. These costs are usually spread over the entire project life and not just during the initial phase of the removal activities. Since elevated levels of DDT-contaminated sediments are addressed in the initial phase of the removal activities, U.S. EPA intends to dispose of them at a subtitle C landfill, thus incurring higher disposal costs.

ALTERNATIVE 2A - Hydraulic Dredging, `Dewatering, and Water Treatment

> **Comment 12-11:** Without knowing the type and size of dredge being considered, the inferred production rate of 700 cy/day is optimistic based on dredging at other sites. Downtime is a significant factor and must be accounted for.

APPENDIX D

Response: hydraulic dredge production rate of 700 yd^3 per day was not presented in the RI/FS Report. EPA's proposed hydraulic dredging alternative assumed the use of two dredges to produce an estimated flow rate of 6,500 gallons per minute (gpm) and a volume of 1,062 in-situ yd^3 of slurry per day. At U.S. EPA's Manistique Harbor site 500 yd' of sediments per day were dredged from depths of 15 to 20 feet and transported by barge. The Velsicol project has improved upon equipment and material handling areas and would utilize 2 dredges to dredge at a depth of 2 to 3 feet and a slurry pipeline to transport sediments which will meet the given production rate. The shallow depth and pipeline transport will increase rates of sediment production.

The commenter indicates its comments are based on its dredging experience but fails to provide a production rate that it believe is realistic, nor does the commenter give any specific information about the type of dredging that occurred or is occurring on these sites and if other factors played a role in lower production rate, assuming the production rates were lower than EPA's estimate.

Regarding downtime, EPA estimated a 30% overall project downtime as part of the estimate. This project is planned to minimize overall downtime by using two hydraulic dredges simultaneously, thereby not requiring a complete shut down of operations if one of the dredges fails to operate. In addition, both the dewatering and water treatment units were designed to meet the estimated daily production requirements. Multiple units of dewatering and water treatment units will be available to minimize complete shutdown periods because of equipment failures. During short periods (1 to 2 hours) of complete shutdown, the dredged material would be stored in settling tanks, inclined plate clarifiers, and the storage tank. When needed, the dewatering and water treatment units can be used during extended work shifts to treat stored material and to maintain the anticipated daily production rate.

Comment 12-12: A major element that is missing from this estimate is the need for debris and/or boulder removal.

Response: This comment is very generalized and does not account for site specific conditions. Based on our extensive sampling, the sediments do not indicate debris at levels of concern to warrant additional screening devices. The material dredged by hydraulic dredging would have sufficient settling time to settle out debris in the settling tanks. Cost estimates were projected based on information available at the time of their preparation

Comment 12-13: It is unclear whether costs associated with moving silt curtains are included in the estimate.

Response: Costs associated with moving silt curtains is not listed separately but are assumed to be part of day to day operation. The necessary equipment and crew is available on-site. An 11- hour dredging period out of a 12-hour work day is used for cost estimates. This 12-hour per day time takes into account the movement of silt curtains and other work needed for securing hydraulic dredge areas. During the initial Superfund setup activities at Velsicol site, already established silt curtains were moved in 25 to 30 minute intervals using barge and crane equipment. EPA does not anticipate the movement of silt curtains in these shallow waters to be a time problem.

> **Comment 12-14:** The potential need for "polish dredging" or capping residual material after dredging has not been included in the cost estimate.

Response: The site is situated in shallow waters where the average zone of contamination is within the top 5 feet of the sediment column, and in many places this is the full extent of sediment so all sediment will be removed down to the clay bottom of the river. The hydraulic dredge considered for this site has onboard global positioning system (GPS) to accurately locate the dredge area and computerized systems to dredge to specific depths. Due to low flow regimes in the river, the potential for sediment migration is minimal and hence polish dredging was not considered unless abnormal concentration depths are encountered. Confirmation sampling will be guided by GPS technologies and any polishing dredging to address abnormal concentrations will be evaluated for specific areas based on this sampling.

Capping residual materials after dredging has not been considered for two reasons. Based on available information, the DDT-contaminated sediment area is well demarcated. This is expected to help in the removal of DDT-contaminated sediments in excess of 10 parts per million (ppm) concentration with available technologies. At DDT concentrations of 5 ppm or less, the overall adverse effects on aquatic animals is drastically reduced. The second reason being that at these low residual concentrations, a very low potential for dissolved phase of DDT exists in water.

> **Comment 12-15:** The description of the alternative indicates environmental monitoring of treated water, downstream surface water, sediment and ambient air during the 3 year project. Costs associated with this monitoring program do not appear to be reflected in the estimate.

Response: Analytical costs for all kinds of monitoring are included in the fuel, utilities, supplies, analytical, miscellaneous materials and services subcategory of consumable materials and services category of the cost estimate table.

> **Comment 12-16:** Based upon our experience at other dredging sites it is likely that a significant amount of time, effort and money will be spent to meet the cleanup goal. Due to many factors residual sediments will remain after dredging and often at concentrations higher than before dredging.

Response: The commenter is not clear on what the comment is and fails to cite specific examples to substantiate their claim. It is true that meeting any kind of removal goal is difficult when dealing with sediment contamination abatement. However, the hydraulic and mechanical dredges (Liquid Flow Technologies and Cable Arm, Inc.) considered for this site will have GPS units on them to accurately locate areas. Dredge units are computerized, and can traverse the desired path with precision and could be programmed to overlap a certain percent, of already dredged area. An added advantage to Velsicol site conditions is the presence of dams at upstream and downstream locations of the dredge area, that could be manipulated to create optimal conditions during the removal alternative. Due to the shallow dredging depths, the dredge passes will be more accurate and the dredge units will encounter limited open water drifts. With all these capabilities, it is anticipated that multiple passes will be minimized, or eliminated.

Comment 12-17: It is unclear what the "Construction Cost" line item includes.

Response: Construction costs include concrete pads, sheds, and other infrastructures needed for water treatment plant, process and storage areas, and other areas of the project.

Comment 12-18: The text indicates that the remedial objectives "could be achieved in two or three construction seasons, but equipment costs are based on only.13 to 14 months.

Response: Actual work would occur only during non-freezing and favorable climatic conditions. At the end of the work season, it is anticipated to demobilize equipment that is cost prohibitive to keep on-site. Hence, such equipment costs are based on the duration of an actual work period. Mobilization and demobilization costs are duly accounted for under mobilization and demobilization costs for heavy equipment category of the hydraulic dredging alternative cost estimate table.

ALTERNATIVE 3A - Mechanical Dredging, Dewatering, and Water Treatment

Comment 12-19: It is highly unlikely that the dredging production rate for this alternative would be similar as for hydraulic dredging.

Response: It is true that typically a single mechanical dredge is less productive than a single hydraulic dredge, but when more than one dredge is used simultaneously, this rationale would not hold true. The cost estimates for this project, irrespective of the alternative selected, were based on meeting preset production rates. Hence, for mechanical dredging alternative, two mechanical dredges would be used. The production rates of these dredges were obtained from Cable Ann, Inc., and a contingency factor of 12% was used to compensate for equipment efficiency due to varying site conditions. The two mechanical dredges would produce a combined dredge rate of approximately 1,300 y^3 in situ sediments per day.

Comment 12-20: Assuming that a 500 gpm water treatment system is adequate for hydraulic dredging, why would a similar capacity system be needed for mechanical dredging?

Response: The commenter misunderstands EPA's treatment design. The water treatment is proposed to handle 500 gpm water for each carbon unit. The mechanical dredging proposed design would consist of 5 carbon units, the hydraulic proposed design would have 12 carbon units.

Comment 12-21: Similarly, why would a dredge slurry pipeline be needed?

Response: The supernatant water/slurry accumulated in the initial container (i.e. barge or dump truck) where the mechanical dredge first dumps the sediments will contain a mixture of sediments and water requiring treatment. The water and the suspended material would be pumped out through the dredge slurry pipeline for treatment.

Comment 12-22: It is unclear how the dredged material is to be dewatered.

Response: The mechanical dredge considered for this project from Cable Arm, Inc., has special features that allow complete embedment of the bucket in the sediments to minimize water intake and also has special sealing features to minimize water leaks. During EPA's treatability study, it was observed that the site sediments dried up within 48 hours after the addition of a drying agent and exposure to atmospheric conditions. However, if addition of a drying agent becomes cost prohibitive, an optional belt-filter press may have to be utilized. The cost of this equipment is not included in mechanical dredging cost estimate table.

Comment 12-23: Comments 12-14 through 12-18 for Alternative 2A also apply to Alternative 3A.

Response: The responses provided for hydraulic dredging are also applicable to mechanical dredging.

ALTERNATIVE 4 - Hydraulic Modification of Pine River, Excavation, Dewatering, and Water Treatment

Comment 12-24: The rationale for the removal production rate implied by estimate is unclear. Excavation in "the dry" is not necessarily faster than dredging, what is the basis for this assumption.

Response: The commenter did not specify production rates equipment types, hydraulic modification procedures, river flow regimes, or other aspects of the project it the referenced sites to justify their comment for this project. Two 4-yd^3 bucket capacity track excavators would be used to produce 1,732 yd^3 of in situ sediments per 12-hour day:

Comment 12-25: It is not clear how the PORTADAMs are to be configured.

Response: This comment is more applicable to a full design document than a RI/FS report. Specific field configurations are usually detailed in a design document.

Comment 12-26: What about the potential need for "polish dredging"?'

Response: This comment is not applicable for this alternative since excavation is not occurring underwater and would not leave residual contamination or result in contamination migration.

Comment 12-27: What about costs for environmental monitoring?

Response: Analytical costs for all kinds of monitoring are included in the fuel, utilities, supplies, analytical, misc. materials and services subcategory of consumable materials and services category of the cost estimate Table 4-5.

Comment 12-28: What does the "Construction Cost" line item include?

Response: Construction costs include concrete pads, sheds, and other infrastructures needed for water treatment plant, process and storage areas, and other areas of the project.

Comment 12-29: The text indicates that the remedial objectives "could be achieved in two or three construction seasons

Response: Actual work would occur only during non-freezing and favorable climatic conditions. At the end of the work season, it is anticipated to demobilize equipment that is cost prohibitive to keep on-site. Hence, such equipment costs are based on the duration of actual work period. Mobilization and demobilization costs are duly accounted for under mobilization and demobilization costs for heavy equipment category of the hydraulic dredging alternative cost estimate table.

ALTERNATIVES 5 AND 6 - Disposal at a RCRA Subtitle D/C Landfill

Comment 12-30: The total tonnage of material appears significantly low. Assuming 50% solids in-situ, an in-situ density of 80 pcf, and 60% solids from the dewatering operations, we would expect a total of approx. 260,000 tons. The mass of drying agents must also be added to the total tonnage.

Response: EPA assumed that one yd^3 in situ volume of sediments translates approximately to 0.65 tons of processed ex situ sediments for disposal based on our experience at the Manistique, Michigan dredging project This translates to approximately 161,250 tons of sediments prior to the addition of a drying agent. The added mass due to the addition of a drying agent at 10% is accounted for in the disposal estimates. The combined total of sediments and drying agent is 178,750 tons and is given under the Disposal of Nonhazardous Waste category of respective disposal alternative tables.

However, if a literature value (one unit volume of in situ sediments approximates to one-third unit volume of sediments) is used for the drying agent, the weight increases to 260,625 to,,9. EPA elected to base the estimate on our experience at Manistique, Michigan rather than on the literature value.

Comment 12-31: It is unclear from the cost what landfill is being assumed (for transport and tipping fee). Based on discussions with a subtitle C landfill in MI, treatment and disposal for DDT sediment would be approx. $300/cy. This is significantly greater than the $65/cy used.

Response: All costs are based on disposal as nonhazardous waste. Disposal costs at a subtitle D landfill are lower than at a subtitle C landfill. The quote obtained for this project is based on the waste being classified as nonhazardous with no additional treatment being completed at the disposal facility.

ALTERNATIVE 7 - In-Situ Capping

Comment 12-32: It is unclear whether the cost associated with moving the silt curtain is included in the estimate.

Response: Costs associated with moving silt curtains is not listed separately but are assumed to be part of day to day operation. The necessary equipment and crew is available on-site as seen in our response to this question under hydraulic dredging.

Comment 12-33: The description of the alternative indicates environmental monitoring will be conducted but the costs don't appear in the estimate.

Response: Analytical costs for all kinds of monitoring are included in the fuel, utilities, supplies, analytical, misc. materials and services subcategory of consumable materials and services category of the cost estimate Table 4-7.

Comment 12-34: It is unclear what the “Construction Cost” line item includes.

Response: The construction costs for this alternative include material storage pads and material loading pads.

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMEDIAL ACTION

ADMINISTRATIVE RECORD
FOR
VELSICOL CHEMICAL COMPANY SITE
ST. LOUIS, GRATIOT COUNTY, MICHIGAN

ORIGINAL
FEBRUARY 10, 1999

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	00/00/00	MDPH		*Toxic Substances Fact Sheet* for DDT DDE and DDD	3
2	05/31/55	MDNR		Report: *A Biological Survey of the Pine River Above Alma to M-30 to Determine Effects of Pollution*	5
3	07/00/57	Courchaine, R., Michigan Chemical Corporation	Michigan Chemical Corporation	Report of Survey: Waste Survey Conducted July 8-11, 1957 at the Michigan Chemical Corporation Site	11
4	00/00/75	Lincer, J., Mote Marine Laboratory		Journal Article: *DDE-Induced Eggshell-Thinning in the American Kestrel: A Comparison of the Field Situation and Laboratory Results* (J Appl Ecol; 12: 781-793)	13
5	10/00/80	Forba, R., National Enforcement Investigation Center	U.S. EPA/ Office of Enforcement	Report: *Pine River Contamination Survey* (June 2-6, 1980)	67
6	04/00/82	Forba, R., National Enforcement Investigation Center	U.S. EPA/ Office of Enforcement	Report: *Summary of Pine River Reservoir Sediment Sampling Survey* (November 20-22, 1981)	30
7	12/27/82	U.S. District Court/Eastern District of Michigan	Respondents	*Consent Judgement* re: the Velsicol Chemical Company Site	52

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
8	06/00/89	USDHHS/USPHS/ ATSDR	U.S. EPA	*Preliminary Health Assessment* for the Velsicol Chemical Corporation (St. Louis Plant Site)	7
9	09/00/93	USDHHS/USPHS/ ATSDR	U.S. EPA	*Site Review and Update* for the Velsicol Chemical Site	17
10	00/30/95	International Joint Commission	U.S. EPA	Paper: *PAH Contaminated Sediment Remediation in the Main Stem, Black River (0H)*	5
11	09/00/95	USDHHS/USPHS/ ATSDR		*ATSDR Fact Sheet* re: DDT, DDE and DDD	2
12	10/25/96	Sakowski, K., MDEQ	Reiner, B., U.S. EPA	Report: *Status of the St. Louis Impoundment in the Vicinity of the Former Velsicol Chemical Company* w/ Cover Letter	185
13	00/00/97	International Joint Commission	U.S. EPA	Paper: *PCB Contaminated Sediment Remediation in Waukegan Harbor (IL)*	7
14	01/00/97	Blasland, Bouck & Lee, Inc.	U.S. EPA	Report: *Response to October 1996 MDEQ Staff Report on the Status of the St. Louis Impoundment*	15
15	10/01/97	Memphis Environmental Center, Inc.	U.S. EPA	*Containment System* Assessment *Report: Volume 1 of 2* (Text, Tables, Figures and Appendices A-H) [FINAL}	863
16	10/01/97	Memphis Environmental Center, Inc.	U.S. EPA	*Containment System Assessment Report: Volume 2 of 2* (Appendix I, Results, Results Appendices A-F) [FINAL]	452
17	12/00/97	Conestoga-Rovers & Associates	U.S. EPA	*Work Plan: Post-Closure Cap Maintenance* for the Former Michigan Chemicals Plant Site	31

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
18	02/20/98	Sargent, L., MDNR	Hanshue, S., MDEQ	Memorandum re: St. Louis Impoundment Sediment Remediation	2
19	06/09/98	Borries, S., U.S. EPA	Ullrich, D., U.S. EPA	*Action Memorandum: Request for a Time-Critical Removal Action at the Velsicol Chemical Company Site* (PORTIONS OF THIS DOCUMENT HAVE BEEN REDACTED)	23
20	06/18/98	Muno, W., U.S. EPA	McMann, T., *Sidley & Austin* and J. Ray, NWI Land Management, Inc.	Letter Forwarding the Attached June 16, 1998 *Unilateral Administrative Order for Access* to the Velsicol Chemical Company Site	25
21	08/00/98	U.S. EPA/ Region 5	U.S. EPA	Streamlined Remedial Investigation Report (Final) for the Veliscol Chemical Site	172
22	09/00/98	U.S. EPA/ OPA	Public	Fact Sheet: *Proposed Plan for the Velsicol Chemical Superfund Site*	5
23	09/02/98	*Morning Sun Mt. Pleasant)*	Public	*U.S. EPA Public Notice* re: Announcement of the September 8 - October 8, 1998 Public Comment Period Concerning Cleanup Alternatives at the Velsicol Chemical Site	1
24	09/09/98	*Morning Sun (Mt. Pleasant)*	Public	*U.S. EPA Public Notice* re: Announcement of the September 16, 1998 Public Meeting Concerning the *Proposed Plan* for the Vesicol Chemical Site	1
25	09/16/98	Bay Area Reporting	U.S. EPA	*Transcript* of the September 16, 1998 Public Meeting re: the Velsicol Chemical Superfund site	87

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
26	10/00/98	Concerned Citizens	U.S. EPA/	Six Letters re: Public Comments Received September 3 - October 7, 1998 Concerning the *Proposed Plan* for the Velsicol Chemical Site	12
27	10/08/98	Phillips, J., Memphis Environmental Center, Inc.	Hill, S., U.S. EPA/ OPA	Letter: MEC's Comments on the *Proposed Plan* and Final Streamlined *Remedial Investigation Feasibility Study Report* for the Velsicol Chemical Site w/ Attachments	36
28	10/23/98	Ecology and Environment, Inc.	U.S. EPA	*Draft Treatability Study Report: Volume 1 of 2 (Text, Tables, Figures and Appendices A-E* for the Velsicol/ Pine River Site	261
29	10/23/98	Ecology and Environment, Inc.	U.S. EPA	*Draft Treatability Study Report: Volume 2 of 2 (Appendices E-P* for the Velsicol/ Pine River Site	622

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES

GUIDANCE ADDENDUM

THE FOLLOWING DOCUMENTS ARE INCORPORATED BY REFERENCE AND HAVE NOT BEEN COPIED FOR PHYSICAL INCLUSION INTO THE ADMINISTRATIVE RECORD

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	00/00/78	Halbert, F. & S. Halbert		*Bitter harvest* (Michigan: Wm. B. Eardmans Publishing Co., 1978)	
2	00/00/80	U.S. House of Representatives		*PBB (Polybrominated Biphenyls) Pollution Problem in Michigan: Hearing Before the Subcommittee on Water Resources of the Committee on Public Works and Transportation* (HR: 6th Congress, 1st Session)	
3	00/00/93	Lorenz		Journal Article: *Containing the Michigan PBB Crisis, 1973-1992: Testing the Environmental Policy Process* (17 Environmental History Review 49, Summer 1993)	
4	00/00/96	Colborn, T., et al.		*Our Stolen Future* (New York: Penguin Books, 1996)	